FEBRUARY

THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

Research in Denture Construction—*Gysi*
Dental Caries and Bacillus Acidophilus—*Bunting, Crowley, Hard and Keller*
Bacillus Acidophilus and Dental Caries—*Jay*
Extraction of Teeth—*Gardner*
One-Piece Casting—*Roach*
Children's Dentistry—*Delabarre*
Oral Pathology—*Hipple*
Cancer of the Mouth—*Rasmussen*
Multirooted Teeth—*Orban and Mueller*
Conservation of Tissue—*Cogswell*
Management of Office—*Lawrence*

EDITORIALS

Need of a Permanent Home
Malpractice Suits Against Dentists

BUREAU OF CHEMISTRY

X-It: A Pyorrhea Remedy

DENTAL HEALTH EDUCATION

Hygienist Question

CONTENTS

Past Presidents of the American Dental Association.....Frontispiece

ORIGINAL COMMUNICATIONS

Practical Application of Research Results in Denture Construction.
By Alfred Gysi, D.D.S..... 199

The Prevention of Dental Caries Through the Limitation of the Growth of Bacillus Acidophilus in the Mouth.
By Russell W. Bunting, D.D.Sc., Mary Crowley, M.S., Dorothy G. Hard, D.D.S., and Margaret Keller, A.B..... 224

Bacillus Acidophilus and Dental Caries.
By Philip Jay, D.D.S..... 230

Postoperative Considerations Regarding Extraction of Teeth.
By Boyd S. Gardner, D.D.S..... 235

Further Progress and Observations in the Treatment of Malocclusion Involving Spaces.
By Hugh Grun Tanzey, D.D.S..... 242

Present Status of the One-Piece Casting for Partial Dentures.
By F. E. Roach, D.D.S..... 249

Oral Function and Children's Dentistry.
By Frank A. Delabarre, A.B., M.D., D.D.S..... 254

Oral Pathology from the Standpoint of the Ordinary Practitioner.
By A. Hugh Hipple, D.D.S., F.A.C.D..... 259

Calcium Metabolism Studies on the Nature and Rôle of the Activators: Researches on Fundamentals for the Prevention of Dental Disease.
By Weston A. Price, D.D.S., M.S., F.A.C.D..... 265

Cancer of the Mouth.
By A. T. Rasmussen, D.D.S..... 287

The Pathology of the Soft Tissues of the Mouth During Childhood.
By F. Blaine Rhobotham, D.D.S..... 294

The Development of the Bifurcation of Multirooted Teeth.
By Balint Orban, M.D., and Emil Mueller, D.D.S., M.S..... 297

The Psychology of Handling the Child Patient.
By Ray W. Noland, D.D.S..... 320

The Conservation of Tissue in Dental Oral Surgery.
By Wilton W. Cogswell, D.D.S..... 326

Economic Factors in the Management of a Dental Office.
By Charles R. Lawrence, D.D.S..... 334

Inlays.
By Herman A. Maves, D.D.S., F.A.C.D..... 347

Unerupted Cuspid: Report of Case.
By C. S. Brazda, D.D.S..... 355

EDITORIAL DEPARTMENT

The Need of a Permanent Home for the American Dental Association.—Malpractice Suits Against Dentists.—Drug Names and the Profession.—Thomas A. Broadbent (1862-1928).—Dana Willis Fellows (1847-1928).—George D. Sitherwood (1844-1929).....356-364

BUREAU OF CHEMISTRY

X-It: A Pyorrhea Remedy..... 365

BUREAU OF DENTAL HEALTH EDUCATION

American Academy of Periodontology Report of the Committee on the Hygienist Question.. 371

Preventive Dentistry.
By Frederick A. Bricker, D.D.S..... 376

CURRENT LITERATURE

Extracts and Abstracts..... 378

MISCELLANY

Book Reviews 382

News 384

Announcements 385

ADVERTISING

Index to Advertisements A-65

Classified Section A-58, A-59

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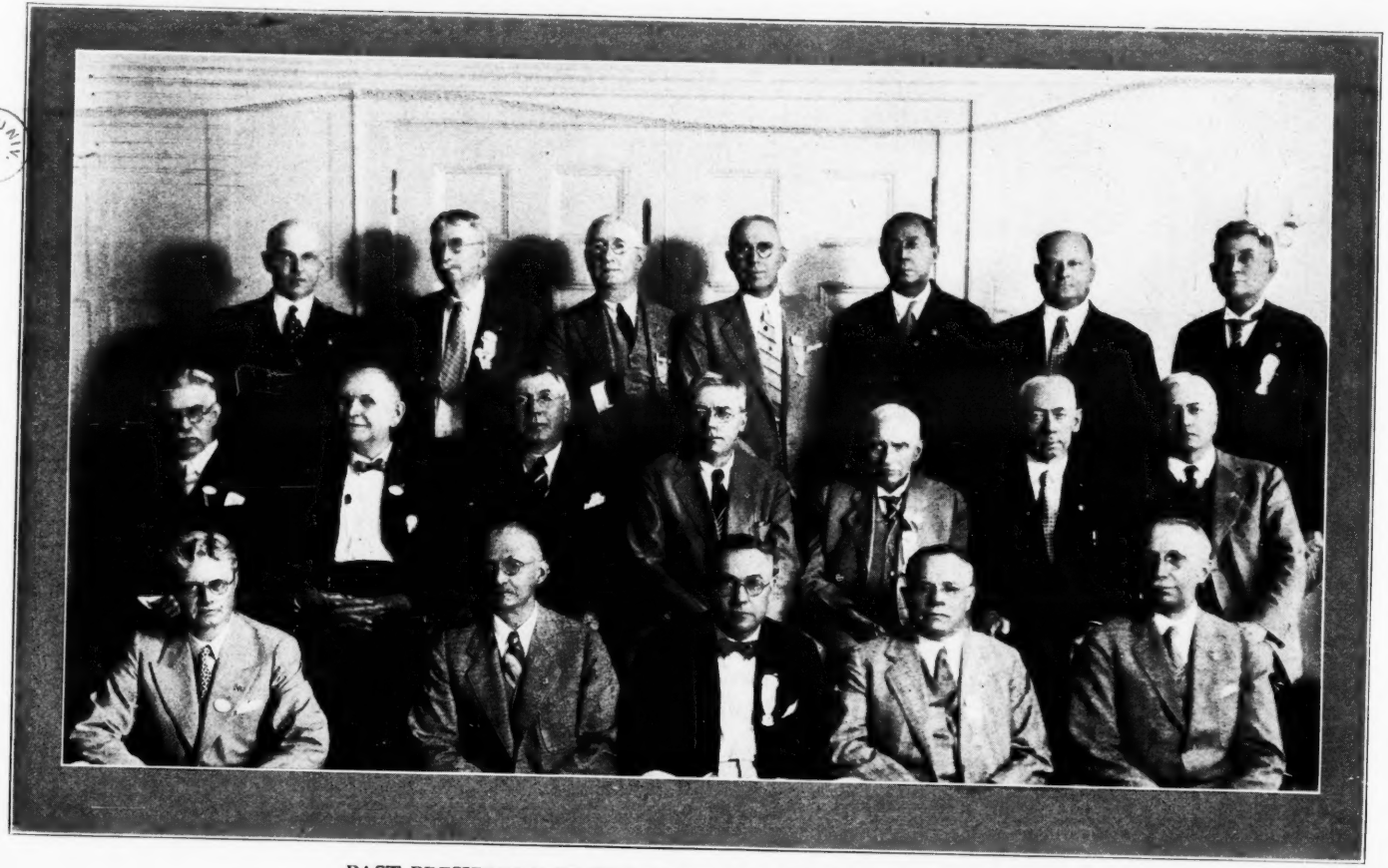

PAST PRESIDENTS OF THE AMERICAN DENTAL ASSOCIATION

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THE JOURNAL
of the AMERICAN DENTAL ASSOCIATION

Vol. 16 FEBRUARY, 1929 No. 2

Original Communications

PRACTICAL APPLICATION OF RESEARCH RESULTS IN DENTURE CONSTRUCTION*

By ALFRED GYSI, D.D.S., Zurich, Switzerland
(Literary Collaboration by GEORGE WOOD CLAPP D.D.S., New York City)

PROBABLY no subject could be more interesting to dentists who are engaged in the construction of artificial dentures and who continually desire to improve the quality of their service than a discussion, by one who has spent most of a long professional life in denture work, of some of the points which are most likely to cause the service to be less than perfect. My active interest in denture construction began forty years ago in the effort to render satisfactory service to my edentulous patients. Since 1888, I have made with my own hands or supervised the making by others of nearly 20,000 full dentures.

In those early days, little was known about mandibular movements, other than the straight opening and closing, and I do not recall that the other movements were considered important. There were no methods nor appliances which we should now call scientific, and the service we rendered was not such as patients now receive in many parts of the world.

Probably about 50 per cent of all edentulous patients exhibit mandibular movements of about average character and much alike on both sides of the head. For such patients, an average arrangement of properly formed teeth on a good nonadaptable articulator can be made fairly satisfactory by spot-grinding and by grinding the teeth in the mouth with an abrasive. But the other 50 per cent cannot be satisfied with an arbitrary, symmetric arrangement of the teeth, and thousands of such patients are today wandering about in this country seeking denture comfort.

One can tell which patients have such average movements only by making cer-

*Read before the Section on Full Denture Prosthesis at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 21, 1928.

tain records for all patients. It is therefore my first principle that, for every patient, there should be recorded the incisor gothic arch tracing and the sagittal inclination of each condyle path. I believe that dentists will, on the average, reduce the time required to render satisfactory denture service by making such registrations and adjustments of the articulator for all patients.

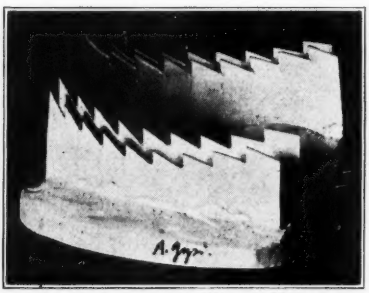

Fig. 1.—Shark's teeth for cutting primary tooth forms.

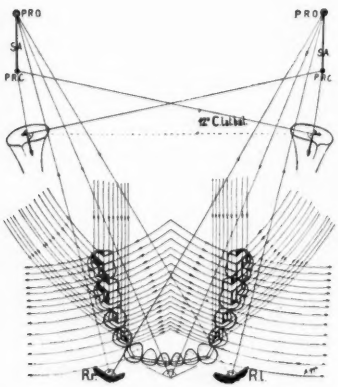

Fig. 2.—Geometric origin of tooth facets from movements around two axes and the protrusive movement.

LIMITATIONS OF THIS PAPER

Let me dismiss from consideration in this paper all matters related to the taking of the impressions, the extension of the dentures and the forms of the borders, and treat only four subjects which, after all these years of experience, seem to me to be of great importance: 1. How

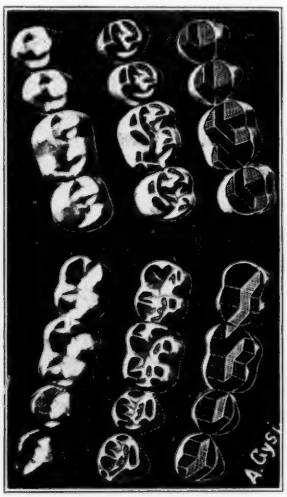

Fig. 3.—Primary and finished tooth forms. Left, finished. Center, intermediate. Right, primary.

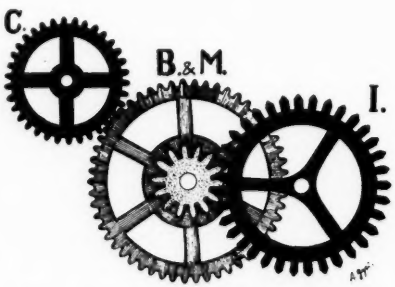

Fig. 4.—Tooth and condyle interaction. *I*, incisors. *B & M*, bicuspids and molars. *C*, condyles.

tooth forms should be designed. 2. What to require in an articulator. 3. How to arrange teeth to give the most satisfactory results. 4. How to modify the tooth forms obtainable in the market to give comfort and efficiency.

NECESSITY OF MANDIBULAR MOVEMENTS GOVERNING TOOTH FORMS

I showed conclusively, several years

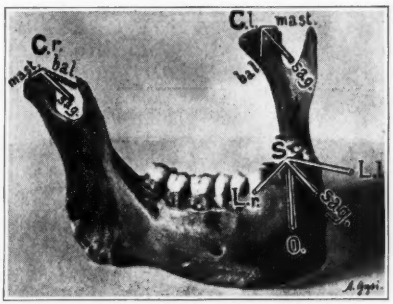

Fig. 5.—Main movements of the incisor point and the condyles, represented by white lines.

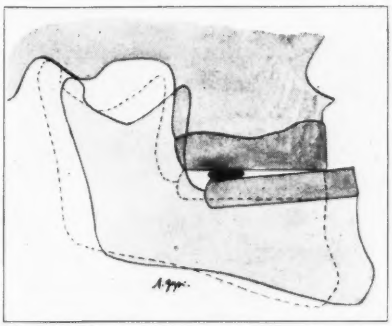

Fig. 6.—Christensen bite method.

ago, that the artificial teeth which are to offer us the greatest opportunities must be correctly carved for the manufacturer, and that this can be done only by reproducing, in a properly constructed articulator, the averages of a large number of mandibular movements. It is our function as dentists to select such teeth

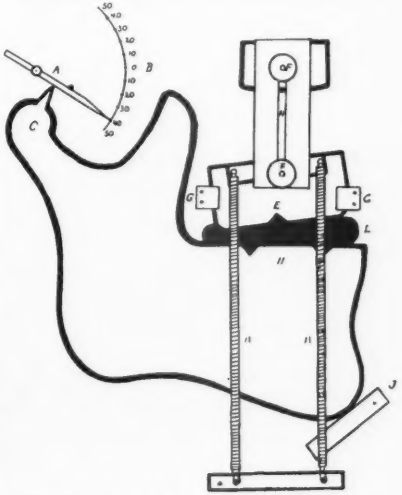

Fig. 7.—Manikin used in testing check-bites. The jaws are of wood and there are no baseplates.

Fig. 8.—Extra-oral method of tracing the incisor gothic arch.

as our raw material and to form on the cusps numerous small, sharp-edged, per-

fectly interacting facets with the inclinations required by individual patients. Only in this way can we hope to secure from artificial dentures the maximum amount of comfort and efficiency.

DESIGNING CORRECT OCCLUSAL SURFACES

From four strips of metal, I cut tooth forms similar to shark's teeth (Fig. 1) and mounted them on a good articulator. A block of plaster was fastened to the opposite model bow, and all the important masticatory movements were made. In the course of these movements, these shark's teeth cut out from the plaster block the primary masticatory surfaces of the maxillary bicuspids and molars.

This program for securing primary forms of tooth surfaces by means of shark's teeth is not quite so simple as it sounds. I began it nearly twenty years ago, and even now, after all these years of experience, it requires about three months of the most exact and arduous work for me to get anything which has scientific or practical value.

GEOMETRICAL PROOF OF CORRECT DESIGN

As a profession, we are often accused of being mechanics and not scientists, and so I have taken the pains to prove by geometric projection and by the most exhaustive mathematical researches that the results I get in this way are scientifically correct.

Fig. 9.—Left: Marker in apex of gothic arch and mandible in centric relation. Right: Registering the lateral incisor path.

Figure 2, one of the simplest of the studies which I have made in this way, demonstrates that if we are given the rotation points for the right and left lateral bites and the protrusive movement, we can determine by purely scientific methods, and without the shark's teeth, the size and inclination of each facet of each tooth.

RESULTING TOOTH FORMS

On the right side of Figure 3, you see the primary forms of the maxillary and the mandibular bicuspids and molars as they were cut from the plaster block by the shark's teeth while they were imitating the human masticatory movements. The black facets are the protrusive facets, cut by the shark's teeth during the protrusive and lateral movements of the articulator. The light facets are the retrusive facets. The facets with the intermediate shading are the balancing facets.

If all the corners and crests are rounded and the clearance sulci are cut,

Fig. 10.—Gothic arch and the record of the protrusive movement. The arms at the sides of the registering table are for the attachment of the face-bow.

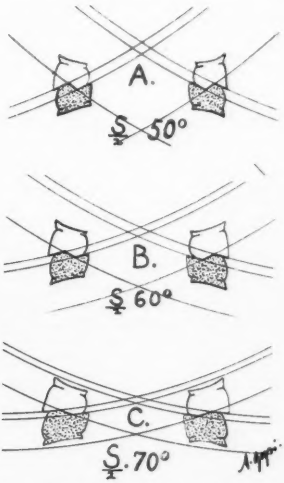

Fig. 12.—Relation of the gothic arch angle to the angulation of the teeth.

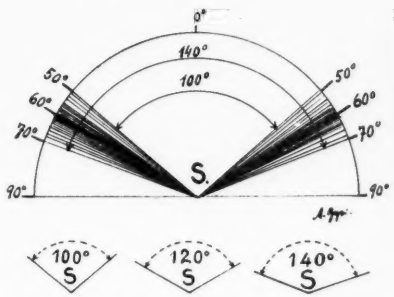

Fig. 11.—Included angle of the gothic arch. In a few persons, the angle includes only 100 degrees, and in a few others, about 140. In most, it includes about 120 degrees.

Fig. 13.—Extra-oral method of recording the sagittal inclination of the condyle path.

the picture in the middle (Fig. 3) is the result. Here, only small areas of the different facets are left. After the baking of the porcelain, even these small facet areas become rounded, and we get the upper and lower tooth forms shown on the left, on which the untrained eye can see no trace of the primary facets; so that one might contend that my theory of tooth facets is pure fancy.

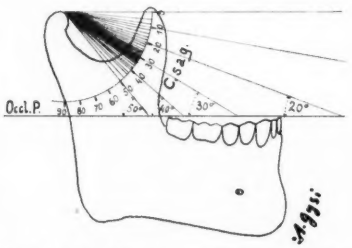

Fig. 14.—Sagittal inclinations of condyle paths. A few persons show an inclination of less than 25 degrees; a few, more than 35. The average is about 30.

This experiment proves that the form of the masticatory surfaces is determined by the interaction of the three condyle and incisor paths.

As dentists, we face the problem of selecting teeth which have been properly formed and of arranging and modifying them so that they will exhibit the maximum of comfort and efficiency.

WHY ARTICULATORS AND TECHNIC ARE NEEDED

The mouth with all of the teeth in place might be likened to a series of three cogwheels (Fig. 4), which we may call *I* for the incisors, *B* & *M* for the bicuspids and molars, and *C* for the temporomandibular articulation. When the mouth becomes edentulous, the cogwheels *I* and *M* are lost, and only *C* remains. It is our task to learn enough from the actions of the wheel *C* and the mountings of the wheel *I* so that we can supply substitutes for the lost wheels in such a way that they will function in harmony with the mandibular movements.

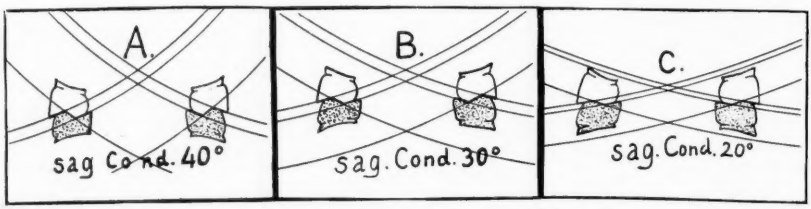

Fig. 15.—Condyle paths and tooth angulation. Steep condyle paths are associated with high cusp molars; medium condyle paths, with medium cusp molars; flat condyle paths, with low cusp molars.

The double wheel *B* & *M* must be so made that the teeth on its rim engage exactly with the gear *C*, while its smaller inner pinion must fit the wheel *I* in every respect. Figure 5 serves to bring out this point more clearly and also to illustrate the fact that we may be allowed some degree of latitude in designing the gear *I*.

WHAT DETERMINES INTERDENTATION

The exact interdentation of the bicuspids and molars during the masticatory movements is determined by the movements of the three main points of the

mandible, that is, the two condyles and the incisor point.

The condyles are capable of making the following definite primary movements. During an incising (protrusive) bite, they move directly or sagittally forward and downward. During a lateral bite, they move slightly inward on the balancing side and outward on the working side. This inward-and-outward movement with relation to the sagittal plane is known as the Bennett movement.

Correspondingly, the incisor point moves forward and downward during an incising bite and more or less laterally during a lateral bite. The record of these movements toward right and left, when traced by the mandible on a recording plate, forms the gothic arch.

These three main movements, and consequently the numerous intermediary movements, have, in each patient, an individual direction and inclination which can be registered and imitated by an adaptable articulator.

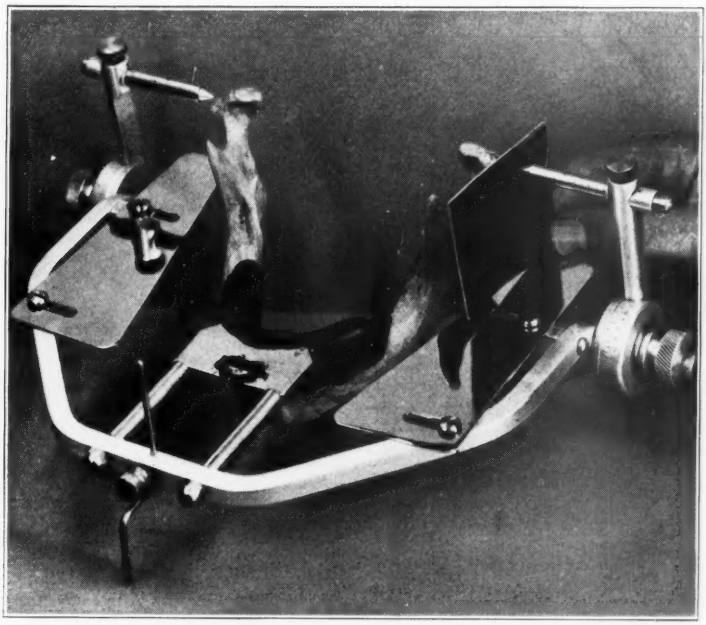

Fig. 16.—Face-bow mounted on the registering table and pencils adapted to the condyle region to register on card, as shown. It is evident that the pencils will make movements practically identical with those of the condyles.

ONE MOVEMENT LOST IN EDENTULOUS PATIENTS

In an edentulous patient, the inclination of the incising or protrusive movement, *S* to *sag.*, is entirely lost; whereas, all the other movements still exist as if the natural teeth were present. Now,

prosthetists can vary this lost inclination at will on the adaptable articulator, although the variation must be made according to reasonable static principles. I propose to show that this modification is very important in many ways.

The opening movement of the incisor point in the direction *S* to *O* we can ignore somewhat if we do not alter in the articulator the height of the bite which we have determined in the patient's mouth. This brings out a point

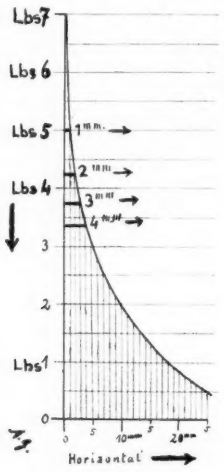

Fig. 17.—Comparative cutting powers of a knife under vertical and horizontal pressure.

which is not sufficiently well understood, that is, that any alteration of the height of the bite is a chair operation and not a laboratory operation. If the height of the bite is to be changed, it is better to do it at the chair, then to detach one cast from its support and reattach it in the new position, than to seek to change the bite by lengthening the incisor pin or by any other similar method.

RELATIVE IMPORTANCE OF THE MOVEMENTS

My conception of the relative importance of these groups of movements has changed greatly during recent years. I now regard the record of the lateral movements of the mandibular incisor point as the most important of all records of movements and that of the sagittal inclination of the condyle path as the next most important. If these are properly recorded, I no longer regard the individual lateral movements of the condyles as important, except perhaps in unusual cases. It is sufficient if the articulator reproduces an average lateral

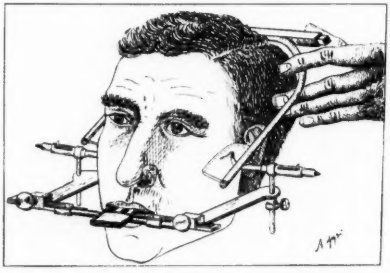

Fig. 18.—Manner of recording the Bennett movement formerly used by author.

condyle path of about 15 degrees.

The sagittal inclination of the incisor path is important, but it is arbitrarily determined to suit each case.

WORKING MOVEMENTS OF THE CONDYLES

We need not register on our patients the working movement of either condyle (*C* to *mast.*), because, in the horizontal plane, this is controlled by the balancing movement of the opposite condyle and the lateral movement of the incisor point.

Only in cases in which the incisor gothic arch is wider than average and

the Bennett movement of the balancing condyle is less than average, the working condyle may go backward or backward and outward and at the same time have a vertical inclination from 5 to 10 degrees different from the sagittal inclination of the condyle path. The only articulators that will reproduce this slight vertical discrepancy of the working condyle movement, as far as I know, are those recently devised by Drs. Hall, Phillips and Stansbery.

A good deal of attention has been given lately to this discrepancy, and some failures in denture construction have been attributed to the neglect to reproduce it in an articulator. I am not able to picture this discrepancy to myself as very important for the following reasons: 1. It occurs in only a few edentulous cases. 2. It is necessarily less than a millimeter in length within the functional range. 3. Only half of the very small resulting error can reach the second molar on the working side, and its effect is entirely lost when the cuspid is reached. 4. The error does not reach any of the teeth on the balancing side.

I believe that the faults in dentures which have been attributed to the failure to record this discrepancy of the working condyle are due to other conditions.

HOW AN ARTICULATOR SHOULD BE DESIGNED

Since the purpose of an articulator is to reproduce as closely as possible the more important movements of the human mandible, it can be designed only by recording all the movements made by many mandibles and selecting those which can be shown to be most important. The axes out of which these movements can be reproduced are located by engineering methods, and a mechanism is formed having similar axes, either fixed or adjustable. That mechanism is an articulator. Not all of the axes need to be made adjustable in a machine suitable for daily use. The value of the articulator will depend on which axes the designer has emphasized, and the knowledge and skill he has displayed in their construction.

Much of the information which I have just given is of only theoretical interest.

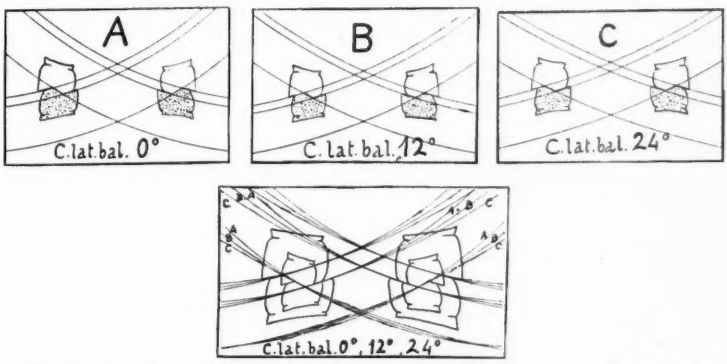

Fig. 19.—Cross-sections of molars showing that, within the range of tooth size and movement, the variation in lateral movements of the mandible is negligible.

WHAT TO REQUIRE IN AN ARTICULATOR

From the practical point of view, the most important consideration in the selection of an articulator is that it shall make it relatively easy for a dentist to establish the following data: centric relation of the mandible; control of lateral incisor point movements, and sagittal inclinations of the condyle path and the incisor path.

It should be possible to use it as a plain-line articulator at certain stages of the work, as an average articulator when such is desired, and as an adaptable articulator with all the range of movement likely to be necessary.

In selecting an articulator, it is well to have a clear mental picture of what the mandibular movements are, of their relative importance, and of how they are reproduced.

FOUR METHODS OF ADAPTING THE ARTICULATOR

The individual adaptation of the articulator, which I believe to be necessary for the best results, at least in many cases, can be made by four methods and their modifications: 1. The intra-oral checkbite method with plastic material (after Christensen). 2. The intra-oral checkbite method with plaster (after Stansbery). 3. The extra-oral graphic method (with the face-bow). 4. The intra-oral dentographic method (after Luce). I prefer the third method because it does not take much time. I shall describe it briefly. The fourth method is not extensively used, and I need not take time to describe it. No improvements of practical importance have been made in it during the last twenty years.

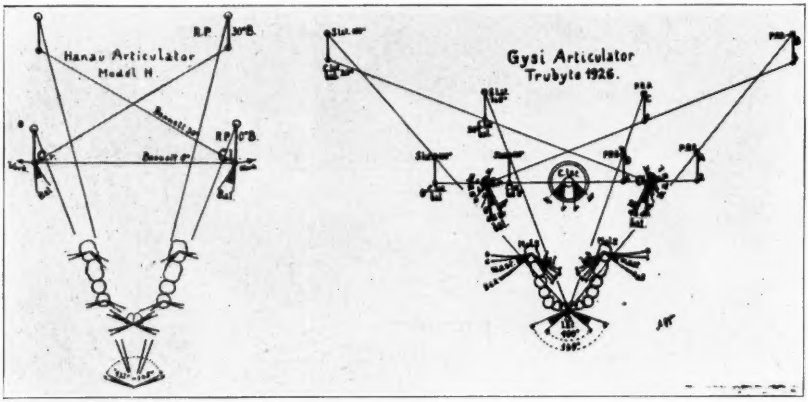

Fig. 20.—Comparative variability of the gothic arch in two articulators and its effect on variability in the molar and condyle regions. The unilateral condyle path control of the Gysi articular is made variable as formerly taught by the author. There is wide variability at the molars.

CHECKBITE METHOD WITH PLASTIC MATERIAL

The purpose of taking checkbites is to enable the dentist to adjust the sagittal inclinations of the condyle paths of the articulator. I began to use this method soon after Christensen intro-

duced it in 1902, but, within a few years, I discovered errors in principle which caused me to abandon it.

Within recent years, this method has been extended, in America, to include the taking of checkbites in lateral occlusion in order to get the lateral condyle and lateral incisor movement. Careful workers soon discovered that the taking of such lateral checkbites with wax or compound was unsatisfactory because it led to great error. They then controlled the lateral checkbites by means of a gothic arch tracing, hoping in this way to escape the errors. But there were causes of error which they did not suspect and could not control.

When this method attained such a vogue in America (and I may say here that it is no longer used much in Europe), at the University of Zurich it was decided to test it on a number of patients. We made one set of full dentures by the checkbite method with wax or compound and one set by the extra-oral method for each of several patients, making the two sets for each patient alike except in sagittal condyle inclination and marking each for our own identification, without the patient's knowledge. We gave the sets, by turns, to the patients to wear. At the end of three months, every patient had returned the set made by the plastic checkbite method and retained the set made by the extra-oral method.

To ascertain the cause of our failures, we constructed a manikin having jaws of wood (Fig. 7) but no baseplates to cause errors, and took many checkbites.

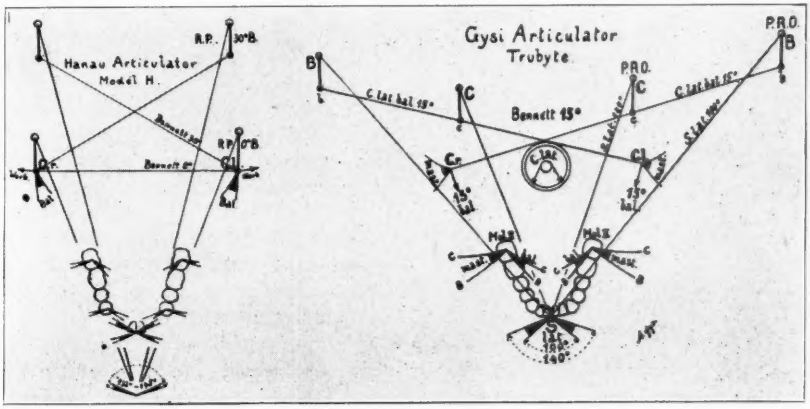

Fig. 21.—Drawings showing that the variability in the molars depends on the variability in the gothic arch and not on the Bennett movement. Here the lateral condyle path control of the Gysi articulator is fixed at 15 degrees, as now recommended by the author. The range of variability at the molars is scarcely affected.

We were never able to get the same registration twice on the manikin. We found the cause of the error to be that as the soft modeling compound which was placed between the jaws to register the relations was compressed by the relatively cool bite rims, it cooled much more rapidly where it was thin than where it was thick, became harder and made unequal pressure on the bite rims. In pa-

tients, this pressure was transmitted to the mucous membrane and created a different condition of resiliency in different locations under the bite rims.

Furthermore, when being placed in position, the soft modeling compound chilled much more rapidly where our fingers touched it than it did elsewhere, and this created the same uneven pressure on the tissues.

I am informed that some of the most careful workers among you are now much dissatisfied with wax or compound

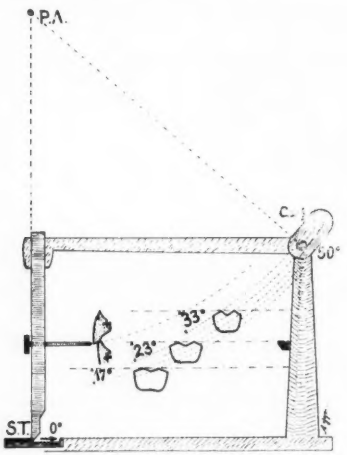

Fig. 22.—Effect on the protrusive facets of placing molars below and above the occlusal plane.

checkbites. Dr. Phillips, of Boston, writes as follows: "In the hands of the untrained, this method is worse than useless," and says that one gets registrations which differ more from reality than an average articulator does in the most unfavorable case.

The only checkbite method that I know to be scientific and practicable is that shown by Stansbery, which uses plaster instead of a plastic material.

THE EXTRA-ORAL METHOD

I shall now briefly describe my extra-oral method of registering both the gothic arch and the sagittal condyle path inclinations. First, I fasten to the mandibular bite rim a registering plate which has been coated with a thin layer of black wax. Then to the maxillary bite rim the elastic registering point is fastened. (Fig. 8.) With this apparatus in place, the patient is instructed to make all kinds of mandibular movements, by which the extreme lateral incisor path, the so-called gothic arch, is inscribed by the stylus on the black wax. (Fig. 9.)

When the registering point is in the angle of the gothic arch, the mandible is in centric relation to the maxilla for this height of bite. This is generally considered to be the most reliable method of establishing centric relation. If the statements by Hight, Campbell and Hanau that not 1 per cent of full dentures are in proper centric relation, and that patients are rarely satisfied with dentures which are out of this relation, are correct, any method that will aid the dentist to get the correct centric relation is of great practical importance.

Figure 10 shows the gothic arch as a patient has registered it. The arms on each side of the registering table serve to attach the face-bow, as we shall see later.

INCLUDED ANGLE OF THE GOTHIC ARCH

The angle included within the gothic arch differs in different patients, as is shown in Figure 11. Here three or four patients have registered an angle of about 50 degrees on each side of the median line, or 100 degrees in all, and three or four have registered about 70 degrees on each side of the median line, or 140 degrees in all, but by far the greatest

number have registered about 60 degrees on each side of the median line, or 120 degrees in all. If the number of registrations were much greater, the proportions would be about the same, and so this included angle of 120 degrees may safely be taken as the average. If the gothic arch is registered farther from the incisor point, the included angle will be greater.

It is important that the articulator reproduce the gothic arch traced by individual patients, because, if that tracing is reproduced in an adaptable articulator and made to control the lateral movements of the incisor point, it will locate the axes for the lateral movements of the artificial denture in approximately identical positions with the axes established by the natural dentition. After centric relation, this is perhaps the most important single adjustment in the entire course of denture construction.

I have proved by solid geometry that the form of the gothic arch combines with the sagittal inclinations of the condyle and incisor paths to influence the angulation of the facets which dentists must make on the masticatory surfaces. In Figure 12, we see the result on the molars, for example, as follows:

A gothic arch of 100 degrees requires the formation of relatively steep facets on the teeth.

A gothic arch of 120 degrees requires facets with average inclinations, which I designed some years ago.

A gothic arch of 140 degrees requires facets with less than average inclinations.

Second in importance in avoiding errors in the construction of a denture is the recognition of the sagittal inclination of the individual condyle path. This I register by fixing the face-bow to the mandibular bite-plate and adjusting the lead pencils to the condyle region. Then, by holding a card firmly against the head, with the lower edge of the card parallel to the face-bow and under the point of the lead pencil, we can register the protrusive condyle path. These steps are shown in Figure 13.

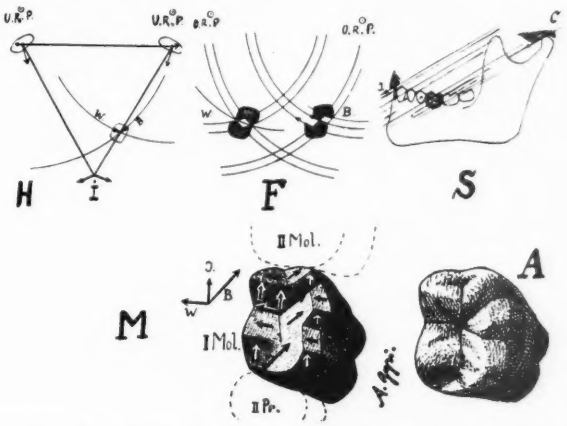

Fig. 23.—Formation of the "food table" on the occlusal surfaces of the mandibular teeth.

If we do this on a great number of patients, we find that the sagittal inclination of the condyle path in relation to the occlusal plane varies from 0 to 50 degrees. In most cases it is about 30 degrees as shown in Figure 14.

I have also proved by solid geometry that this movement combines with the form of the gothic arch and the sagittal inclination of the incisor path to influence the angulation of the facets to be formed on the masticatory surfaces of the molars. In Figure 15, we see the result, as follows:

A sagittal condyle path of 20 degrees necessitates flat angulation of the facets.

A sagittal condyle path of 30 degrees necessitates medium angulation of the facets.

A sagittal condyle path of 40 degrees necessitates relatively steep angulation of the facets.

Many dentists seem to feel that there is something mystical about this extra-oral method. Figure 16 shows that the face-bow and the mandible form one solid body, and if a card is held between the condyle and the registering lead pencil, the latter is bound to make the same movements as the condyle during a protrusive movement.

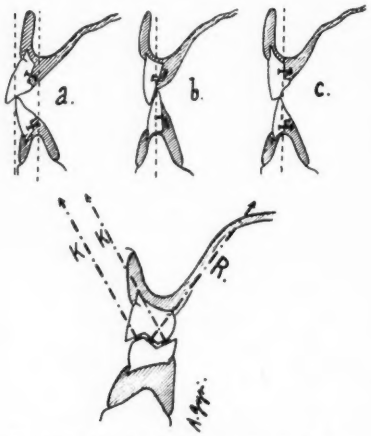

Fig. 24.—Mechanical incorrect and correct positions of artificial teeth.

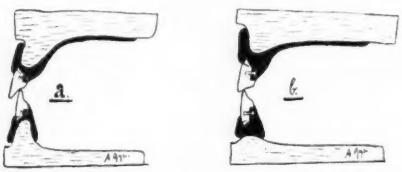

Fig. 25.—Tooth surfaces and denture stability. Relations at *a*, instability; relations at *b*, stability.

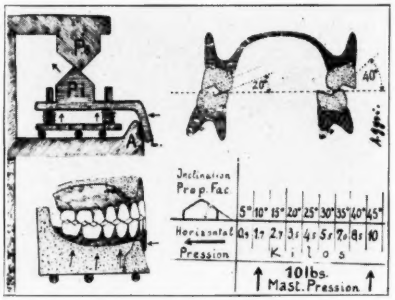

Fig. 26.—Effect of biting pressure and cusp angulation in side thrust, measured in pounds.

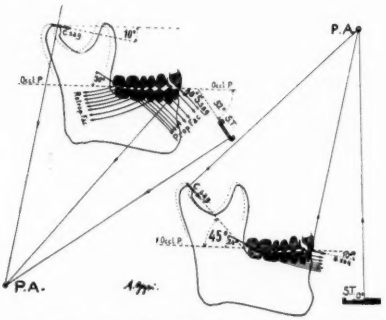

Fig. 27.—Combined effect of the sagittal inclinations of the condyle and incisor paths on cusp angulation.

The contention is made that this method is not absolutely accurate. This is true, because an error of ± 5 degrees may be made. However, since the wax and compound checkbite method develops errors as great as ± 25 degrees, I feel that we may safely adopt the pencil method as accurate enough for practical purposes. If an adaptable articulator is set to the individual sagittal condyle path and to the individual gothic arch, and if the teeth are ground with carborundum, the patient can easily perform gliding movements with the artificial teeth, by which the fiber-cutting power is largely increased.

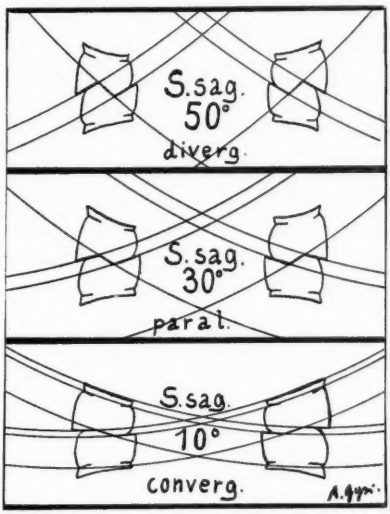

Fig. 28.—Effect of the sagittal inclination of the incisor path on transverse angulation of the molars.

I have demonstrated this increase in cutting power (Fig. 17) by an apparatus on which I can measure the cutting power of a knifeblade when only vertical pressure is applied, and when in addition there is a horizontal movement.

This table shows the result. If a vertical pressure of 7 pounds was applied, a string could be cut through, but if a horizontal movement of 4 mm. (one-sixteenth inch) was added, the same string was cut with only 3½ pounds of vertical pressure.

This principle is true for artificial teeth also. The gliding movement in a protrusive or a lateral bite largely increases the cutting power. And for a good digestion, we need finely cut fibrous food.

There remains now only the lateral condyle path or the Bennett motion to be considered. Every known means of registering this movement is either so cumbersome or so inaccurate as to be inefficient. Figure 18 shows the method which I formerly employed for making this record. I have proved by solid geometry that it is not necessary to make an individual Bennett adjustment on our adaptable articulator. Here is the result:

A, B and *C*, Figure 19, show cross-sections of molars as they would be needed for 0, 12 and 24 degrees, Bennett movement. In the lower part of this figure, these three cross-sections are drawn upon one another, and you can easily see that they do not differ in the least in their cusp angulations. The errors that might result from differences in the inclination of this movement are smaller than the unavoidable errors made during impression taking and bite taking, setting up the teeth and the flasking and vulcanizing process.

Therefore, we need not trouble ourselves, provided the articulator allows an average movement of 15 degrees Bennett, because the Bennett error is then only half as large as it is in this picture.

LATERAL VARIABILITY OF THE HUMAN MANDIBLE

The incisor point of the mandible is capable of longer lateral movements than are the condyles, but its range of variation between the extremes is not so great. The gothic arch variation, on one side, is from about 50 to about 70 degrees, a range of 20 degrees, while the condyle path may vary from 0 to 50 degrees.

The lateral movements of the incisor point are more important to the prosthetist than are the lateral movements of the condyles, because they can be more accurately recorded and are more effective in adjusting the articulator.

It is in the highest degree desirable that an articulator resemble the mandible in having sufficient lateral variability at the incisor point. The lateral variability at the condyles is not important.

If an error is made in reproducing the incisor path, the full amount of that error will be shown in the relation of the incisors and cuspids; and faulty cuspid relation is a frequent cause of denture displacement. Such an error may arise because the path was not recorded, or because the articulator is incapable of reproducing that path.

If, in an articulator on which the lateral path of the incisor point is properly controlled, an error as great as 15 degrees is made in reproducing the lateral paths of the condyles, that error at the condyles will not affect the positions or articulation of the teeth on the working side, and only a trace will appear in the second molars on the balancing side.

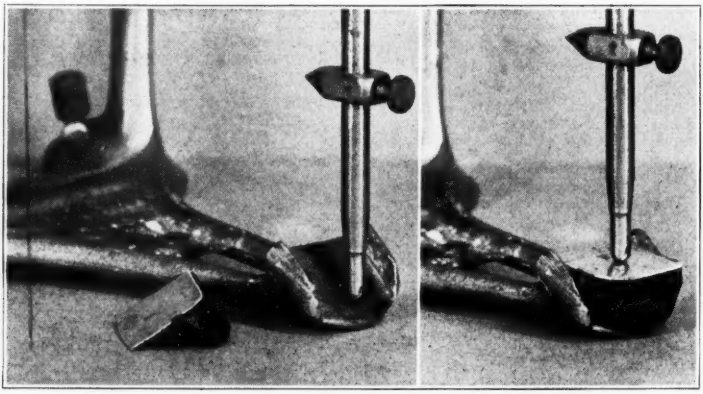

Fig. 29.—Left: Simplex incisor guide incline. Right: Guide showing how the inclination may be modified at will by the use of compound and sheet metal.

COMPARATIVE IMPORTANCE OF LATERAL INCISOR AND CONDYLE PATHS

Why are errors in the lateral incisor path more important than errors in the lateral condyle path?

In most mandibles, the second molars are about half-way between the incisor point and the condyles, so that practically all of the teeth lie in the half of the mandible adjacent to the incisor point and are strongly influenced by its lateral movements, while the condyles are so far away that they influence the lateral movements of the teeth but little, and

control by the incisor point renders that slight influence wholly negative.

If the lateral path of the incisor point of the articulator is not controlled and the dentist depends only on the lateral paths of the condyles for control of the lateral movements of the artificial teeth, dangerous errors can result, if the patient has a gothic arch movement that the articulator has not.

Good incisor point control is rendered doubly important by the fact that it is very difficult to record the lateral paths of the condyles accurately. It is partly for this reason that the latest form of my adaptable articulator has been given a wide range of adaptability at the incisor point, where control of the lateral path is most effective, and a considerable range of movements at the molars is the result. After all these years of study and experiment, I cannot help feeling that these are the characteristics in an articulator that are most helpful to the prosthetist.

Figures 20-21, left, show the horizontal movement of the Hanau articulator, Model H. This articulator has great direct variability of the lateral movement at the condyles (from 0 to 30 degrees), but a very small variability of the gothic arch. On this account, the condyle paths of the articulator have a large field of variation on the balancing side (as shown by the black triangles), but the teeth have a very small field of variability. Compare the black triangles of the working and balancing sides of the second molars in both pictures. The working side condyle of Hanau's Model H has no field of variation at all, only a more or less wide range of horizontal thrust.

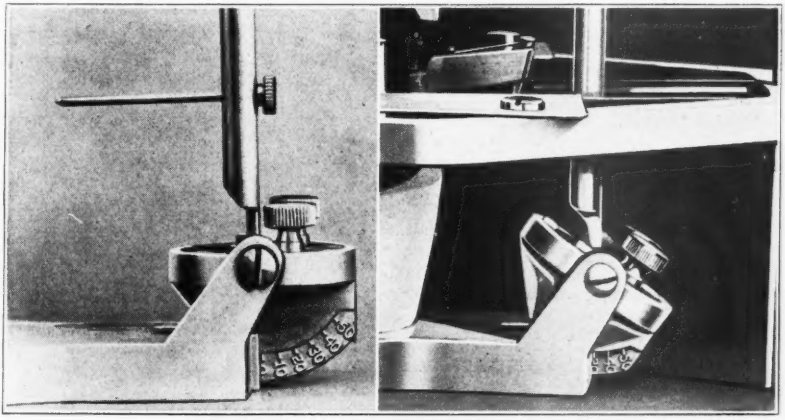

Fig. 30.—Horizontal and steep adjustments of the articulator incisor path.

Even if the Bennett adjustment on my latest articulator is left for all cases on an average of 15 degrees and only the gothic arch is adapted individually, the field of variability of the molars is much greater than on Model H. The Hanau kinoscope allows for the adaptation of the gothic arch.

THE IMPORTANCE OF MOUNTING CASTS CORRECTLY

A second purpose of the face-bow is to

enable us to mount the plaster casts accurately on the articulator. I believe that I can show the necessity of a face-bow for any articulator with an intercondylar axis whenever the sagittal inclination of the incisor path differs from the sagittal inclination of the condyle path.

Figure 22 shows diagrams of three molars. The lower one is below the occlusal plane and farther from the intercondylar axis than it will be in the mouth. The second is in the occlusal plane and at the right distance from that axis. The upper one is above the occlusal plane and too near that axis. The distance above or below the occlusal plane is less important than the distance from the intercondylar axis.

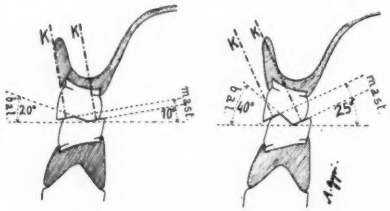

Fig. 31.—Diagram showing that a shallow sagittal inclination of the incisor path lessens the inclination of the facets on the occlusal surfaces and the tilting force against the molars. Left: Shallow facets, no tilting force. Right: Steep facets, strong tilting force.

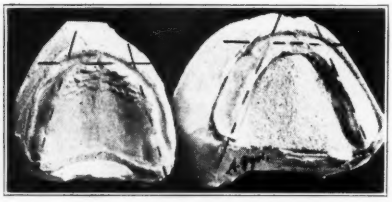

Fig. 32.—Lines along the alveolar crests prolonged on the casts.

In the middle molar, which is at the right distance from the intercondylar axis, protrusive grinding with carborundum will incline the protrusive facets at 23 degrees to the occlusal plane. The same grinding will incline these facets on the molar which is too far forward at only 17 degrees and on the molar which is too far back at 33 degrees. Lateral grinding will incline the working and balancing facets on all these teeth in the same way. If an inclination of 23 degrees is required for articulation in the mouth, inclinations of 17 and 33 degrees may cause slight cusp interference, and the dentist may be unable to discover the source of his unsatisfactory result.

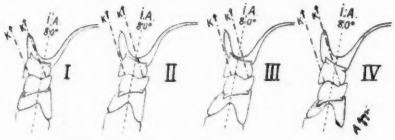

Fig. 33.—Molar positions with relation to the interalveolar crest line.

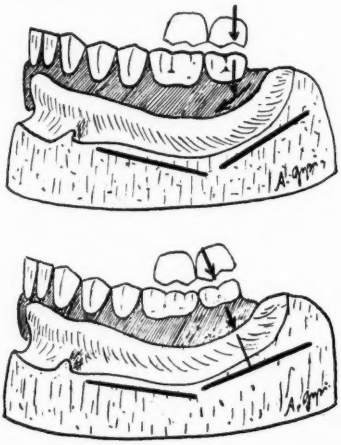

Fig. 34.—Ridge form, molar positions and dislodging or retaining forces.

INFLUENCE OF DIVERGENT SAGITTAL PATHS ON CAST POSITION

It will be noticed that, in this dia-

gram, the sagittal inclination of the condyle path is 50 degrees and that of the incisor path is 0 degree. Many middle-aged edentulous patients present such inclinations of the condyle path; but for full denture construction, a sagittal inclination of the incisor path of more than 30 degrees is never necessary or advisable, because it will insure dislodging the dentures and accelerate resorption of

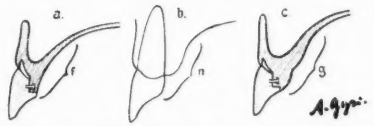

Fig. 35.—Vulcanite form and enunciation. Concave form at *a* hinders enunciation; convex form at *c* favors enunciation.

THE WADSWORTH UNIVERSAL ARTICULATOR

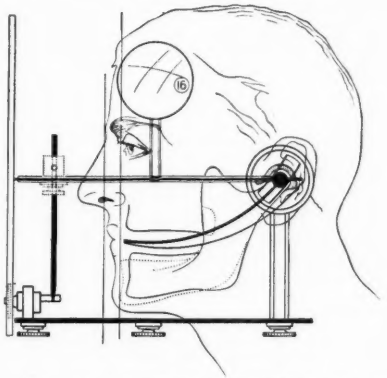

Fig. 36.—Practical application of the Wadsworth curve to molar positions.

the ridges. In cases with good ridges, the inclination of the incisor path may well be about 30 degrees. In proportion as the ridges are less than high and firm, this inclination of this path may be reduced until, in what I call "desperate cases," that is, those with steep condyle paths and flat or flabby ridges, it may be 0 degrees, as is shown here.

In cases in which the sagittal inclinations of the condyle and the incisor paths are identical, it makes no difference where the casts are mounted, high or low, front or back. But in proportion as the sagittal inclinations of the condyle and incisor paths diverge, it becomes increasingly important that the casts be mounted in right vertical and anteroposterior relations in all articulators having an intercondylar axis.

As the dentist cannot alter the sagittal inclination of the patient's condyle path, and should not depart greatly from it

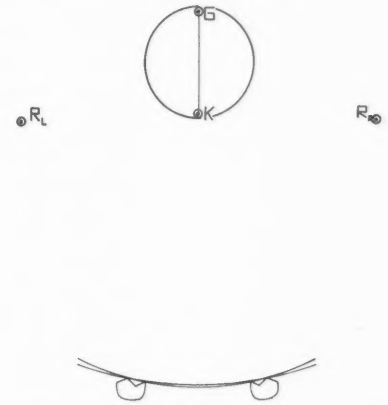

Fig. 37.—Practical application of the Wadsworth center to the transverse tooth curve.

in the articulator if he desires good articulation, and as he must establish a much flatter sagittal inclination of the incisor path than the patient had with his natural teeth, there will often be a wide divergence between these two path inclinations, and this necessitates the use of a face-bow in mounting casts on most articulators.

IMPORTANCE OF PROPER TOOTH FORMS

We have seen that dentists should modify small areas of the occlusal sur-

faces of teeth as they come to them to suit the movements of the individual patients, without destroying the general form. It can be shown that such a procedure is of the utmost importance to the health of the patient.

All the functions of mastication are dependent on the exact interaction of numerous small, sharp-edged facets on opposing teeth. By means of such facets, fibrous food is cut and all food is triturated. Properly formed mandibular bicuspids and molars constitute what Tench and Clapp have called the "food table," on which food rests by gravity, to which it is continually returned by the cheeks and the tongue, and where it is held by the fossae, grooves and cusps until it has been properly cut and smashed. Against such a surface, properly formed maxillary teeth act with a minimum of effort and a maximum of efficiency. Such a foodtable, for a lower first molar, is illustrated in Figure 23.

The search for health is turning more and more people away from soft and refined foods and back to the bulky and fibrous foods of our ancestors. We must do our part in making possible the mastication of such foods by the edentulous. If we provide them with a properly formed food table and accurately opposing teeth, we shall make our maximum contribution to their good health and long life.

PLACING TEETH OVER THE RIDGE

One of the primary requirements of denture construction is that the artificial teeth be placed as nearly as possible over the alveolar ridge to insure stability and guard against any tipping or dislodging of the dentures. It is not sufficient that only the neck of the tooth be over the ridge; if the teeth are to articulate, the cutting edge, or masticatory surface, as well must be in proper ridge relation.

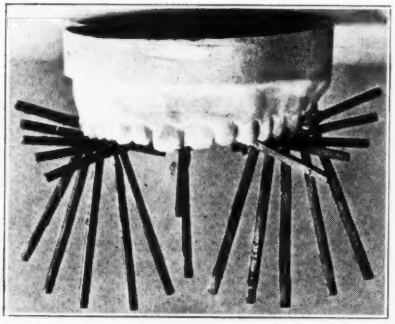

Fig. 38.—Cast with rods projecting downward placed at right angles to the occlusal surfaces of the posterior teeth. Only the rods over the second molars point to the Wadsworth center.

Fig. 39.—An easy method of measuring the inclination of the interalveolar crest line.

The position at *a* (Fig. 24) is wrong. Also, the deep overbite at *b* is wrong. The best arrangement is shown at *c*, with the cutting edges as nearly as possible in the interalveolar ridge line and with a shallow overbite.

It is not always possible to combine the best esthetic effect with the greatest

degree of mechanical efficiency. If, for esthetic reasons, we find it necessary to set the maxillary incisors anterior to their original position over the ridge, the mandibular incisors should not occlude with them.

In the molar region, the cosmetic effect need not be considered. Here, comfort, stability and efficiency are of the utmost importance. On the molars, the tilting forces *K* are acting on the working facets, and these forces may easily overcome the retention forces *R* on the balancing facets if the teeth are not placed in proper position over the ridge. Therefore, the tilting forces *K* should not fall far outside the buccal borders of the dentures.

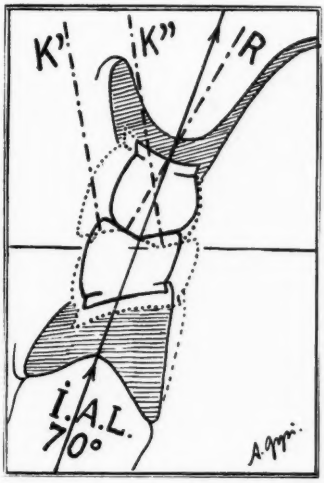

Fig. 40.—Case of advanced resorption with special teeth for cross-bite setups, which increase the stability and comfort.

HORIZONTAL FORCES AND WHAT THEY MEAN

A vertical biting force directed against an oblique surface produces a horizontal thrust which tends to dislodge the denture and accelerate resorption of the ridges. Therefore, the arrangement *a* (Fig. 25) is wrong, and the arrangement *b* is desirable. This horizontal thrust might also result if the teeth were not correctly formed nor arranged for the movements of the patient.

The importance of this horizontal thrust to the comfort and the health of the patient is not so well appreciated by dentists in general as it should be. Thousands of dentures are constructed annually in which this force is continually active because centric relation was not properly secured.

Fig. 41.—Mandibular alveolar ridges with small cross-section which should be protected from heavy pressure.

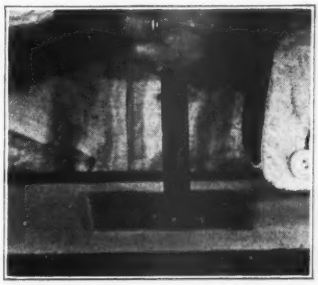

Fig. 42.—Ruler in position which makes it impossible to press it through a sheet of wax.

An engineer has calculated for me that if a vertical biting force of about 10 pounds acts on cusp facets with an inclination of 45 degrees, the whole biting

force is transformed into a horizontal shift of about 10 pounds. Even a cusp inclination of 25 degrees produces a horizontal shift of about 4½ pounds. In some cases, this horizontal force may be reduced by friction.

In Figure 26, there are shown at the left two experiments which any dentist can easily make to demonstrate the transformation of vertical force into horizontal force. In the lower right corner, a table shows the effect of different cusp angulations on the distribution of vertical biting force.

The protrusive facets, therefore, during an incising bite, produce a backward shift on the mandibular denture, and the working side and balancing side facets produce a lateral shift during a lateral bite.

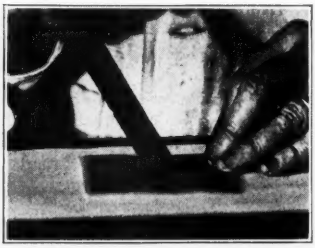

Fig. 43.—Ruler in position which allows forcing it through the wax with a very slight pressure.

These findings make it easy for us to understand why dentists have such poor results with high-cusp molars. Happily, these shifting forces are minimized during meals because of the fact that the food particles produce an opposing force on the retrusive and the balancing facets. If no food is between the teeth, these shifting forces become very dangerous and detrimental to the alveolar ridges.

HOW TO AVOID STEEP FACETS WHICH CAUSE HORIZONTAL THRUST

In the picture on the left, Figure 27, we have a condyle path of only 10 degrees. If, in conjunction with this condyle path, the sagittal inclination of the incisor guide is made steep, high-cusp molars are necessary to insure articulation. The steep protrusive facets produce a strong horizontal thrust on the mandibular denture, which destroys the alveolar ridge.

In the picture on the right, Figure 27, we have a steep condyle path of 45 degrees, which would necessitate high-cusp molars; but because the incisor guide on the articulator has been set at 0 degrees, the molar cusps become much lower. The incisor overbite also is flatter. These relations minimize horizontal shifting forces and thus tend to conserve the underlying ridges.

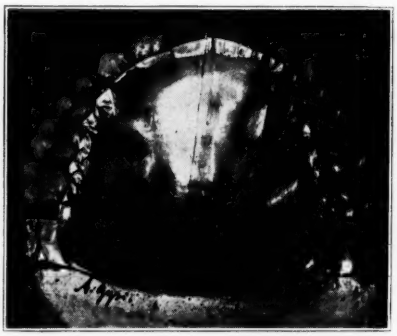

Fig. 44.—Sheet of No. 60 tinfoil placed after the teeth have been waxed to minimize the shrinkage of the rubber.

The transverse cusp inclinations also can be made more favorable by this arrangement. The time is too short to give the full geometric proof, so I shall give only the results of my researches. On the articulator, an incisor guide of

50 degrees, in conjunction with an average, or 30 degree, condyle path would require high cusps and steep facet inclinations.

An incisor guide of 30 degrees would give medium facet inclinations, and an incisor guide of 10 degrees would give shallow facet inclinations, when the teeth are ground with carborundum. (Fig. 28.) These shallow inclinations for the lateral bites will produce a minimum of horizontal thrust on the mandibular denture.

Figure 29 shows how my simplex articulator can be adapted to produce

Fig. 45.—Vulcanization of black rubber: left, with tinfoil; right, without tinfoil.

shallow-cusp bicuspids and molars, during the milling-in process, by affixing a horizontal piece of sheet metal over the incisor guide and securing it in place with modeling compound. Figure 30 shows steep and horizontal paths for my latest adaptable articulator.

Let us bear in mind the fact that the flattening of the incisor guide plane results in shallower facet inclinations, and therefore in lessened danger of shifting of the dentures and the resulting resorption of the alveolar ridge.

The tilting leverage also can be reduced by this arrangement. In the picture on the left, Figure 31, it is evident that, in shallow-cusp molars, the outer tilting force *K* falls within the border of the denture; while in the picture on the right, where the molars have been ground with a steep incisor guide of 40 degrees, the tilting force falls outside the border of the denture and the denture is easily dislodged.

LOCATING THE CRESTS OF THE RIDGES

In order that we may know the position of the crest of the alveolar ridge on the plaster models, lines should be drawn along the ridges before the baseplates are adapted and should be ex-

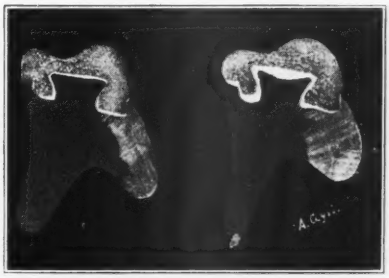

Fig. 46.—Vulcanization of black rubber about pins: left, with tinfoil; right, without tinfoil.

tended to the side walls of the casts. By this means, we are sure to place the teeth, especially the bicuspids and molars, well over the ridges. (Fig. 32.)

FOUR WAYS OF SETTING MOLARS OVER THE RIDGE

The molars can be set over the ridge in four different ways. In Figure 33, *I*, the interalveolar line passes through the lingual third of the teeth. Here, the tilting force *K* on the buccal facets becomes active, because it falls far outside the buccal border of the denture.

In *II*, the interalveolar line goes through the center of the teeth, and the

tilting force *K* falls not far outside the denture border. This is the best position.

In *III*, the interalveolar line passes through the buccal third of the teeth. This produces the least dangerous tilting force, but the teeth reduce the tongue space, and the tongue, being so crowded, has a tendency to dislodge the mandibular denture.

In *IV*, the teeth are well set midway in the interalveolar line as in *II*, but the maxillary molar is set too far below the ridge. This produces a great leverage on the maxillary denture, and the tilting force *K* therefore becomes greater.

The arrangement in *II* avoids this error and makes the mandibular denture heavier and the maxillary denture lighter, a condition that is also more favorable.

MAKING THE TOOTH CURVE CONFORM TO THE RIDGE CURVE

The teeth should be set to conform somewhat to the curve of the alveolar ridge, so that the masticatory force falls perpendicular to the ridge. Compare the positions of the second molars in Figure 34.

In the upper figure, the line of force against the second molar is not perpendicular to the ridge, and hence will have a tendency to cause the denture to shift forward. The lower figure shows the correct position, with the line of force perpendicular to the ridge. Lines drawn on the plaster model parallel to the ridge will facilitate setting the teeth at the proper angle.

ARRANGING ANTERIOR TEETH FOR ENUNCIATION

The factor of proper enunciation in speech is of nearly as great importance to the wearer of dentures as mastication. The letters *s*, *c* and *z* are as a rule the greatest stumbling blocks, and we may aid our patients in attaining proper enunciation by building the lingual surfaces to a convex rather than a concave arc.

In Figure 35, *a* is incorrect; *c* is correct.

THE WADSWORTH BASIC CURVE

Wadsworth's method of establishing the curve of Spee is illogical because of the fact that very often, in order to avoid cutting the heels of the casts, its direction must be changed arbitrarily. This requirement is shown by the heavy line in Figure 36.

THE WADSWORTH CENTER FOR THE TRANSVERSE CURVE

For the transverse tooth curve also, the Wadsworth center plate is illusory, because the curve drawn from the center *G* (Fig. 37) does not differ materially from the curve drawn from the center *K*. Of course, these two curves differ in their totality, but not at all over the two cusps of the left and right molars.

The Wadsworth center is wrong in another respect also. It is true only for the second molar, which can be proved in the following manner: Place rods over the masticatory surfaces of the maxillary teeth and to them affix perpendicular rods. Only the rods over the second molars point toward the Wadsworth center. (Fig. 38.)

THE INTERALVEOLAR RIDGE LINE

When the alveolar ridges are so resorbed that the interalveolar ridge line is inclined at less than 80 degrees to the occlusal plane, it is no longer possible to get fully satisfactory results with the anatomic molars, because the tilting forces on the maxillary buccal facets become more and more active. Figure 39 illustrates an easy method of determining the inclination of this line.

For these cases I have designed the cross-bite molars, which have no buccal cusps and therefore no buccal facets. In these the tilting force K' (Fig. 40) falls well inside the border of the denture and the force K'' becomes a stabilizing rather than a tilting force.

The smaller the cross-section of the mandibular alveolar ridge, the narrower the masticating surface of the molars should be. For such cases, I often make so-called all-bicuspid dentures, using no molars at all, to protect the tissues under the denture from traumatic injury. (Fig. 41.)

We can readily understand this engineering principle if we try to press through a sheet of pink wax at room temperature with the broad end of a ruler. (Fig. 42.) We cannot succeed in spite of exerting all possible force. But as soon as we tilt the ruler on its edge, we can do it with very little pressure. (Fig. 43.)

CHANGES DURING VULCANIZATION

It is discouraging to have carefully followed the various steps of impression taking, bite registration and tooth arrangement and then have all efforts at accuracy offset by faulty vulcanization.

On maxillary dentures, a sheet of No. 60 tinfoil placed on the lingual surface after the case has been waxed up minimizes the shrinkage of rubber. (Fig. 44.)

For example, Figure 45, right, shows an incisor vulcanized on a black rubber plate without the use of tinfoil. This cross-section shows the enormous shrinkage of the rubber. Figure 45, left, shows the effect of the use of tinfoil. The shrinkage is inconsiderable.

Figure 46 shows the same effect on two diatoric molars. The right one was vulcanized without the use of tinfoil, and the left one with tinfoil on the outside of the denture.

Black rubber exhibits the greatest degree of shrinkage and pink rubber the least, but pink rubber is lacking in strength. Red rubber seems to strike the medium of combined strength and a fairly low degree of shrinkage.

The occlusion and articulation of the teeth suffer greatly from these changes which take place in the process of vulcanization, and the errors which are so produced must be corrected. Let the patient wear the dentures for three or four days, then take a checkbite by Dr. Tench's method, and mill the teeth in on the articulator with carborundum.

When I received the invitation to make the long journey from my home to this country, for which I had to give up my holidays in the Alps that I love so well, I felt no hesitation in coming to a favorable decision.

For many years it has been an especial pleasure to bring to America the story of my findings in the prosthetic field, because you have always received them with such keen intelligence and such a warm welcome. And I can see that through your application of sound principles, the level of full denture service is steadily rising.

I am sorry that I cannot express to each of you personally my appreciation of your kindness, but I shall carry back to my far-away home and into my future work the pleasantest memories of the great hospitality with which I have everywhere been received.

THE PREVENTION OF DENTAL CARIES THROUGH THE LIMITATION OF THE GROWTH OF BACILLUS ACIDOPHILUS IN THE MOUTH*

By RUSSELL W. BUNTING, D.D.Sc., MARY CROWLEY, M.S., DOROTHY G. HARD, D.D.S., and MARGARET KELLER, A.B., Ann Arbor, Mich.

IN our previous contributions[1] to this subject, we have presented evidence in support of the view that dental caries is an infective disease and that *B. acidophilus* is the specific etiologic factor. With this concept of the problem as a working basis, we have, during the past year, studied the behavior of this organism in the mouth and the means of inhibiting its growth and caries-producing proclivities. We have found that it does not inhabit the mouths of all people, and in those in which it is found, there may be periods in the life of the individual when it disappears. As a rule, it may be said that, during early childhood, and up to 8 years of age, the organism is present in about 35 per cent; at the ages 8 to 20 years, from 85 to 95 per cent are affected, and at over 20 years, there is an apparent decrease in its occurrence, to about 50 per cent. The chronologic appearance of the organism corresponds closely to the periods of greatest caries activity in the average individual.

It was found that, in those mouths in which there was no growth of *B. acidophilus,* an active immunity against that organism can be demonstrated. To a group of seven adults whose mouths were free from *B. acidophilus,* a quantity of acidophilus milk was fed daily over a period of one week, at the end of which time the organism could not be found in the mouth. Thus, it appears that, in them, some immune principle exists which militates against the growth and propagation of *B. acidophilus* in that environment. In such mouths, that organism is continuously absent and dental caries does not occur. In cases which we have observed over a period of time, we have noted that when the immunity ceases and *B. acidophilus* appears in the mouth, cavities may occur thereafter in the teeth for the first time in the life of the individual. This immune reaction constitutes, therefore, a direct controlling influence on dental caries.

*From the Laboratories of the School of Dentistry, University of Michigan.

*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 22, 1928.

1. Bunting, R. W., and Palmerlee, Faith: Rôle of B. Acidophilus in Dental Caries, J.A.D.A., 12:381 (April) 1925. Bunting, R. W.; Nickerson, Gail, and Hard, Dorothy G.: Further Studies of the Relation of B. Acidophilus to Dental Caries, Dent. Cosmos, 68:931 (Oct.) 1926. Bunting, R. W.; Nickerson, Gail; Hard, Dorothy G., and Crowley, Mary: Further Studies of the Relation of B. Acidophilus to Dental Caries; II, Dent. Cosmos, 70:1 (Jan.) 1928.

Two other agencies have been demonstrated which exercise a controlling influence on the growth of *B. acidophilus;* namely, dietetics and therapeutics. We have previously reported that we found the best dental conditions and the lowest activity of *B. acidophilus* in the mouths of a group of children who, for a number of years, had been fed on a well-balanced diet from which sugar had been largely eliminated. In the experimental feeding of rats, we found that these animals, when fed a normal well-balanced diet, do not have dental caries; but when we fed them a normal diet plus 5 gm. of sugar daily, *B. acidophilus* appeared in their mouths and dental caries ensued.

During the past two years, we have been conducting dietary experiments on a number of children in orphanages to determine whether alteration of the diet would produce any appreciable reduction of dental caries. Two groups of children were studied, consisting of 150 in the Michigan Home and Training School in Lapeer, Mich., and 350 in the Maumee (Ohio) County Children's Home. In both instances, a well-balanced diet was prescribed, from which white flour and sugar was eliminated as far as possible. In the Lapeer group, 106 children have been on the diet for one year or more, of which seventy gave positive reactions to tests for *B. acidophilus* at the beginning of the experiment. The reaction of twenty-five of these became negative and has remained so. In twenty-one, it has varied from positive to negative, showing evidences of low-grade activity. In twenty-four, the reaction remained positive, but of these only eight showed any evidence of caries activity. Of the thirty-five in whom the reaction remained negative throughout, in not one case was there any evidence of caries; while, in three cases in which the reaction changed from negative to positive during the experiment, all had cavities in the teeth for the first time.

In the Maumee group, a similar reduction was noted, but not so pronounced as in the former, probably owing to the fact that these children had many cavities which were unfilled. Among the 228 children who were on the diet for one year or more, 167 gave positive reactions to *B. acidophilus* at the beginning of the experiment. The reaction in fifty-four of these became negative and remained so, and forty were variable. In fifty-three, it remained positive, and, in thirty-eight of these, caries appeared to be active. Of the sixty-nine in which the reaction remained negative throughout the experiment, none showed any evidence of caries, but of twelve whose reaction changed from negative to positive, ten developed cavities in the teeth.

From the data thus far obtained, it appears that the adoption of a well-balanced diet from which sugar and white flour have been excluded produces a marked decrease of *B. acidophilus* in the mouth. This effect was not uniform. In some, the organism was completely eliminated; in others, it was not. The bacteriologic data are based on qualitative and not quantitative estimations, so that, although many mouths still reacted positively to *B. acidophilus,* the number and activity of the organisms may have been appreciably diminished. This is borne out by the statement of the dentist in charge of the children in Lapeer, who says that those children who have been on the diet require little attention, differing markedly in that respect from those who have been on the regular institutional fare. It was also

interesting to note that the children in the experimental group were generally healthier, made normal increases in height and weight and were freer from infectious diseases than were the remainder of the school.

It has been suggested that, by the use of antiseptics which are especially antagonistic to *B. acidophilus,* the growth of this organism in the mouth might be controlled and the incidence of dental caries be thereby reduced. In our former publications,[2] we have described the use of metaphen in conjunction with oral prophylaxis and have stated that, when used in the manner described, it will eliminate *B. acidophilus* from the mouth in about 50 per cent of cases and will greatly reduce it in the remainder. When used as a mouthwash, it seems to have little effect. It appears that the organisms of dental caries lie on the surface of the teeth beneath a waterproof film which this drug is unable to penetrate.

More recently, we have found that hexylresorcinol (S.T. 37), when used solely as a mouthwash will, in many instances, completely eliminate the microorganism of caries from the mouth, and if used regularly, will keep the mouth free from that infection. In a group of thirty-six patients, all of whose mouths gave positive cultures of *B. acidophilus* and all of whom had carious teeth, twenty-four gave negative reactions within from two to eight weeks from the use of hexylresorcinol, 1:1,000, three times daily, no other treatment being given. Thus, it appears that this drug is especially adapted to the purpose, and, as it may be used by the patient, it may prove to be a most valuable agent for the control of dental caries.

In an effort to determine what might be done by the use of metaphen in conjunction with oral prophylaxis, the following experiment was conducted. In the Protestant Orphans Home in Detroit, sixteen children were selected, ranging in age from 6 to 16 years. All of these children had carious teeth and oral cultures were positive for *B. acidophilus.* The cavities in their teeth were filled and they were given a metaphen treatment on three successive days, and one each month over a period of one year. No other treatment or dental attention was given during that time. The diet, which was not ideal from the dental health standpoint at least, was not changed. The time devoted to each child at each monthly treatment was not more than from five to ten minutes.

As a result of this treatment, six children gave a negative reaction to tests for *B. acidophilus* after the first three treatments, continuing to do so throughout the year. In them, there was no evidence of caries, although one had teeth that were pronouncedly hypoplastic and another lost a filling. The cavity remained open but was not actively carious. In six children, the reaction remained positive throughout the experiment; four of the six had caries, but not more than two cavities each. There was a total of six cavities for the four children, of which two were recurrent beneath fillings. Four children varied from positive to negative in the cultures which were taken each month throughout the year. Of these, one child had one recurrent cavity.

Unquestionably, there was a marked reduction of caries in the mouths of these children as the result of the metaphen treatments. It might be confidently

2. Footnote 1, second and third references.

expected that children who were susceptible to caries would have from two to five cavities each during the period of one year. In this group of sixteen children, twelve had no caries and four had a total of seven cavities, three of which were recurrent.

Since we have found that certain types of *B. acidophilus* are somewhat resistant to metaphen while others show a similar action to hexylresorcinol, we are now recommending that both of these preparations be used for the control of dental caries, in the following manner:

The mouth is first charted, all open cavities, fillings and the general condition of the teeth being recorded. All open cavities are filled at once with either permanent or temporary materials as the conditions may require. The mouth is then given a thorough prophylactic treatment, special attention being given to the removal of all films from the surfaces of the teeth. This operation may be greatly expedited by the use of rubber engine polishers charged with an abrasive. Metaphen 1:500 is then applied topically and carried into the proximal spaces with floss. The patient is then given a mouthful of metaphen 1:5,000, which is held in contact with the teeth for one minute. This procedure is repeated on from three to five consecutive days. The patient should then be instructed to brush the teeth thoroughly and to use hexylresorcinol (S.T. 37) diluted with four parts of water as a mouthwash once every day, holding the solution in contact with the teeth for one minute. In particularly active cases, an occasional metaphen treatment may be given by the dentist.

As we obtain further information on this subject, our method of treatment will undoubtedly be changed, but, from our present knowledge, we are convinced that the procedure outlined, in conjunction with a well-balanced low-sugar diet, will yield a high degree of success in the control of dental caries, and we strongly recommend it to all practitioners as a practical preventive measure.

CONCLUSIONS

1. Certain individuals have a distinct immunity to the growth of *B. acidophilus* in the mouth which may persist from birth to old age or may appear and disappear at intervals throughout life. During the periods of immunity, large quantities of *B. acidophilus* may be ingested without that organism becoming implanted in the mouth.

2. By experimental feeding of a well-balanced diet, from which sugar and candy were practically eliminated, to a large group of children over a period of one year, it was found that they developed normally and were in good health and that the growth of *B. acidophilus* in the mouths and dental caries were markedly reduced.

3. Hexylresorcinol (S.T. 37), when used as a mouthwash, was found to be effective in the reduction of *B. acidophilus* in the oral field.

4. In a group of sixteen children susceptible to caries, to whom metaphen treatments were given each month over a period of one year, there developed during that time a total number of seven cavities, of which three were recurrent.

5. The use of metaphen by the dentist as a topical application to the teeth after oral prophylaxis and of hexylresorcinol (S.T. 37) by the patient as a mouthwash is recommended for the control of dental caries.

DISCUSSION

E. H. Hatton, Chicago, Ill.: Dr. Bunting, there is a request that you tell us the nature of these antiseptics, metaphen and others. What is the nature of these drugs? Can they be put up by any druggist?

Dr. Bunting: Metaphen is a preparation made by the Abbott Chemical Company. It is a benzin derivative, and belongs to a general group of organic antiseptics, of which there are a large number. It has been found that the particular linking of mercury, cresol and the NO radicals to the benzin ring adds a very high antiseptic property to this preparation, which is called metaphen. At the same time, it has a very low toxicity. There is a little mercury in it. Metaphen is not a proprietary preparation, in the sense that it is a secret preparation; it is simply one of the organic antiseptics which is made by the Abbott Chemical Company. It is, as far as I know, only put out by them. It may be obtained from any druggist who can order it directly from the Abbott Chemical Company in North Chicago. Hexylresorcinol is known more commonly as Solution S.T. 37, S.T. meaning surface tension; that is, this solution works on the principle of lowered surface tension. It is a resorcinol compound, another complicated organic structure the exact nature of which I cannot give you. It has been formulated by Veader Leonard of Johns Hopkins University, who has suggested this formula as an antiseptic for general purposes, in that it exhibits strong antibacterial qualities and is almost nontoxic. It is made by the firm of Sharp & Dohme of Baltimore. They are putting it out in a solution of 1:1,000, a colorless, transparent, tasteless, odorless, nontoxic, highly aseptic preparation. It seems too good to be true. It has a glycerin base, with a very slight sweetish taste. We have tried eight or ten well-known preparations and found that not one of them is effective as a mouth wash, except hexylresorcinol. It cannot be put up by any druggist, but he can buy it by the carload from the manufacturer if he wishes to. I am sorry that I cannot suggest a preparation that you can compound yourself. If this drug really is what it appears to be, I think it is worth all we have to pay to get it. S.T. 37 is universally carried by druggists.

G. W. Clapp, New York City: I am interested in some work for children who are all physically defective, in one of our open-air schools at home. This year, I was not able to get any dental help for the children, and they had such a high percentage of cavities—from nine to fourteen for each child—that not much could be hoped for; but I was able, by cooperation with the teachers of the class, to put the children on a liberal fruit diet, the fruit being supplied from outside, and we did what we could by moral suasion to reduce the percentage of candy consumed. There are 1,100 children in that school and they spend over $30,000 a year for candy. Can you give us any information about the inclusion of liberal quantities of fruit in the diet? With these children, I provided all the oranges they could be persuaded to eat. They ate all the way from two to seventeen per child each day. The teacher's reaction was "a definite improvement in general condition and spirit"; but of course no improvement took place in the mouths, and the reports of the tuberculous contact cases do not show any improvement in the charts. Next year, I hope to have these mouths put in good shape and to try a fruit diet again. But I should like to know whether you have tried that out, or whether you can give us any light that would help in a particular case of the sort. These are children frequently lacking home care, some of them susceptible to being turned away from the path that they are taking. A great deal can be done for them.

Dr. Bunting: There are two important points in animal and child dietary experimentation as they relate to dental caries: (1) a well-balanced diet, and (2) the reduction of sugar and fermentiscible carbohydrates to the minimum. For instance, in Iowa City it was observed that, in a group of diabetic children, caries was arrested. The observers thought that the balanced diet was responsible. The important consideration was that these children had been deprived of sugar and carbohydrates. In Rochester, Minn., a group of children were placed on a ketonic (low starch) diet, and caries was checked. I asked a noted nutritionist how nearly we could eliminate sugar from the diet without harming the child. And he replied, "Take it all out." What the effect of fruit acids on caries would be, I do not know.

I do not believe they will offset the danger of $30,000 worth of candy a year.

Dr. Clapp: I know three people very intimately, my two sons and myself, who were candy addicts for many years. After following Percy R. Howe for quite a while, I went home and I presented to the boys, as Dr. Howe had to me, a conception of the advantages of liberal quantities of orange juice. By supplying ourselves with plenty of fruit sugar, we have satisfied the craving for refined sugar. The organic acids do not seem to do a particle of harm, because we take a glass of water with each orange.

Dr. Bunting: What about the economic side of it—the cost of the fruit sugars?

Dr. Clapp: If the candy and the oranges cost the same, I should think the oranges were worth about forty times as much as the candy. One of my boys had stopped growing, and he was subject to colds, as well as distressingly susceptible to dental caries. Nowadays, a cold means little to him. He takes hot baths, gets into bed, eats eight or ten oranges a day, abstains from other food and recovers rapidly. He is sometimes able to go to a dance the first or second night. He has learned that the earlier he institutes such treatment, the more rapidly he recovers. And he has started growing again. These cases are too few to justify any conclusions, but they are straws in the current. The organic acids appear to be used up so rapidly and combine so readily with the carbonates in the blood that they seem to disappear, and we have been unable to get any adverse effect. Dr. Donnelly, of Detroit, who has a large practice, states that he has not lost a case of incipient pneumonia, tonsillitis or influenza in two years. He employs enemas the first day and puts the patient into a hot bath twice daily. He limits the food to as much orange or grapefruit juice as the patient likes, up to three dozen a day.

Dr. Bunting: Someone asks how we recognize or isolate *Bacillus acidophilus*. It is difficult. It cannot be done with smears, but must be done by special technic, which can be accomplished only by a careful technician who will actually study the method. The ordinary bacteriologic clinician in the city will not do this. But I do not think that you actually need to employ this technic, because, when a mouth shows widespread caries, we know that the organism is there. If we institute this treatment and the caries stops, that is sufficient.

A. L. Walters, Tulsa, Okla.: Within three to six hours after the birth of an infant, *Bacillus acidophilus* can be removed from the colon. As long as *Bacillus acidophilus* and other types of acid-forming organisms are present in a degree to maintain an aciduric flora, just so long is the resistance of that infant exceedingly high. There is no putrefactive odor to the stools. This is true not only of babies, but also of all animals. As long as the child can maintain a normal aciduric flora, just so long will we have a normal mouth secretion, certainly one which is rich in antibodies and enzymes, and one which is capable of acting as an antiseptic. And just to the degree that our intestinal flora varies from the normal aciduric flora do the secretions of the mouth change. I have enjoyed thoroughly, not only this year but also in times gone by, the papers of Dr. Bunting, and I have often wondered why he did not correlate the mouth flora with the intestinal flora and determine the influence of a well-balanced diet and a normal intestinal flora on the mouth flora. In other words, I should like to know whether *B. acidophilus* can proliferate in the mouth of a child fed on the kind of a diet which would maintain the normal aciduric intestinal flora. That the feeding of acidophilus milk over a period of a week will not cause any evidence of caries in the teeth of the group of immune children, I should expect. On the contrary, I should expect it to increase the immunity or decrease the susceptibility. This should be a splendid way to obtain immunity, because we should be carrying into the body in large quantities the organism which prevents intestinal putrefaction, the toxic products of which can have nothing but a deleterious action on every cell of the body. The acidophilus is a friendly organism in the colon because it liberates lactic acid, and lactic acid is inimical to the growth of proteolytic organisms; but lactic acid in the mouth will decalcify tooth structure; and therefore, in the mouth, it is anything but friendly. *B. acidophilus,* with other lactic acid-forming bacilli, proliferates in a carbohydrate medium, and it would seem that the ability to recover *B. acidophilus* in harmful quantities from the mouth would indicate that there was carbohydrate material on, or about, the teeth

for its proliferation; and if this débris was removed or, better still, was not ingested in such form that it would adhere tenaciously to the teeth, it would be quite easy to get rid of *Bacillus acidophilus* by taking away its food supply. We may feed our child or our adult patients who have unclean mouths, coated tongues and putrid breath on acidophilus milk, lactose, lactodextrin or some form of carbohydrate that will not be digested and absorbed from the small intestine, before it reaches the colon; increase the fruits and vegetables in the diet and restrict meat and eggs, with the result that the mouth becomes clean and the breath sweet; but only when the intestinal flora is changed to an aciduric type and the constipation is overcome. Few men are in a position to do more for us than Dr. Bunting, and I sincerely hope that he will continue his work and will find time to compare the mouth flora with the intestinal flora of his susceptible and immune groups, and determine the part that refined carbohydrates play in making the teeth susceptible to caries, through the action of the acidophilus or other microorganism.

George R. Warner, Denver, Colo.: One case does not prove anything; but after Dr. Bunting's visit to Colorado, we were very much interested in this matter of *Bacillus acidophilus.* Our first case was that of a man past 40, with rapidly progressive caries. We found, after using metaphen, that cultures were still positive; but the patient has had no more caries.

Dr. Bunting (closing): If any of you will write me at the University of Michigan, Ann Arbor, I will be glad to send you a reprint of the paper that I have read in which there is included the method which we suggest. I hope that you will try it on cases that are the most hopeless, and that, in nine months' or a year's time, you will write to me and tell me what has happened.

BACILLUS ACIDOPHILUS AND DENTAL CARIES*

By PHILIP JAY, D. D. S., Rochester, N. Y.

IN a previous paper,[1] a close correlation between the incidence of *Bacillus acidophilus* and the occurrence of dental caries in a group of twenty-two children was reported. Eight children with carious teeth yielded cultures that were positive for *Bacillus acidophilus,* while the organism was obtained from only four out of fourteen children who had no clinical evidence of dental caries. The report also stated that, within six months, three of these four children developed carious lesions, while those from whom we could not obtain the organism remained free from dental caries at the end of that year.

Since the publication of that report, it has been possible to reexamine some of these children. In one case that had been consistently positive for *B. acidophilus* in the absence of dental caries, several large cavities developed during this time. Only five of the ten children who had continued free from caries and

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*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 22, 1928.

1. Jay, P. and Voorhees, R. S.: Bacillus Acidophilus and Dental Caries, Dent. Cosmos, 69:977 (Oct.) 1927.

TABLE 1.—SUMMARY OF CASES

June, 1928

Case	Treatments	B. acidophilus	Caries
24	6	—	None
25	7	—	None
28	8	+	3 pit cavities
29	7	+	7 cavities
31	10	—	1 pit cavity
40	11	+	1 cavity
41	12	—	None
42	11	+	1 pit cavity
43	11	—	3 pit cavities
53	6	—	None
54	7	—	None
55	7	—	None
56	7	—	None

TABLE 2.—CASE DATA*

Date of Culture	B. acidophilus	Caries
Nov. 10, 1927	—	
Dec. 7, 1927	+	
Jan. 4, 1928	+	
Jan. 18, 1928	+	
Feb. 1, 1928	+	
Feb. 15, 1928	+	
March 23, 1928	+	
April 18, 1928	+	
May 4, 1928	—	
June 1, 1928	+	
June 8, 1928	—	3 cavities

*Case 43 (boy, aged 8).

TABLE 3.—CASE DATA*

Date of Culture	B. acidophilus	Caries
Nov. 7, 1927	—	
Dec. 7, 1927	—	
Jan. 4, 1928	—	
Jan. 18, 1928	+	
Feb. 1, 1928	—	
Feb. 15, 1928	—	
March 23, 1928	+	
April 18, 1928	—	
May 4, 1928	—	
June 8, 1928	—	1 pit cavity

*Case 31 (boy, aged 9).

TABLE 4.—CASE DATA*

Date of Culture	B. acidophilus	Caries
Nov. 30, 1927	—	
Dec. 7, 1927	+	
Jan. 8, 1928	—	
Feb. 8, 1928	—	
March 26, 1928	+	
April 16, 1928	+	
June 1, 1928	+	3 pit cavities

*Case 28 (boy, aged 7).

TABLE 5.—CASE DATA*

Date of Culture	B. acidophilus	Caries
Nov. 30, 1927	—	
Dec. 7, 1927	—	
Jan. 8, 1928	+	
Feb. 8, 1928	+	
March 26, 1928	+	
April 16, 1928	—	
June 1, 1928	+	7 cavities

*Case 29 (boy, aged 9).

the organism were located, and it was found that four still showed a negative reaction for *B. acidophilus* and had no caries, while one gave a postive reaction for the organism and presented two occlusal cavities.

The consistency with which *Bacillus acidophilus* has been isolated from cases of dental caries by Howe, Rodriguez, McIntosh and Bunting, and in this laboratory, indicates that this organism can, without a doubt, be isolated from every case of dental caries. Bunting has shown that, as a general rule, *Bacillus acidophilus* is not present in caries-free mouths; and, in our previous studies, as long as a mouth remained free of *B. acidophilus,* caries did not occur, but with the advent of the organism, the teeth invariably became carious.

During the past year, an attempt was made to prevent the onset of caries by prophylactic treatments with metaphen. Twenty-six children who had no caries and from whom we failed to obtain *B. acidophilus* were selected for this study. One-half this number were to receive prophylactic treatments at two-week intervals and the remainder were to be observed as controls. The treatment used was that outlined by Bunting;[2]

2. Bunting, R. W.: Nickerson, Gail, and Hard, Dorothy G.: Further Studies of the Relation of Bacillus Acidophilus to Dental Caries, Dent. Cosmos, 68:931 (Oct.) 1926.

TABLE 6.—CASE DATA*

Date of Culture	B. acidophilus	Caries
Nov. 10, 1927	—	
Dec. 7, 1927	+	
Jan. 4, 1928	—	
Jan. 18, 1928	—	
Feb. 1, 1928	—	
Feb. 15, 1928	—	
March 23, 1928	—	
April 18, 1928	—	
May 4, 1928	—	
June 1, 1928	—	
June 8, 1928	+	1 carious fissure

*Case 40 (girl, aged 10).

TABLE 7.—CASE DATA*

Date of Culture	B. acidophilus	Caries
Nov. 10, 1927	—	
Dec. 7, 1927	—	
Jan. 4, 1928	—	
Jan. 18, 1928	—	
Feb. 1, 1928	—	
March 23, 1928	—	
April 16, 1928	—	
April 18, 1928	—	
May 4, 1928	—	
June 1, 1928	+	
June 8, 1928	+	1 occlusal pit cavity

*Case 42 (boy, aged 7).

that is, the teeth were carefully polished and metaphen 1-500 was applied to all surfaces of the teeth and carried between the teeth with dental floss. The patient was then given a 1-5000 solution of metaphen to hold in his mouth for two minutes.[3]

After seven months, six of the thirteen children so treated developed carious lesions, while of the control group who received no treatment, caries occurred in only three. The attempt to prevent the onset of dental caries was apparently not successful; but in the course of this experiment, the striking relationship between *Bacillus acidophilus* and dental caries was brought to light with even greater emphasis.

3. These patients were selected and treated by Ralph S. Voorhees, Jr., D. D. S., and Ethelyn Verwey, D. H., Rochester, N. Y.

TABLE 8.—CASE DATA*

Date of Culture	B. acidophilus	Caries
Nov. 21, 1927	—	
Dec. 7, 1927	—	
Feb. 8, 1928	—	
March 26, 1928	—	
April 16, 1928	—	
June 1, 1928	—	No caries

*Case 24 (boy, aged 8).

TABLE 9.—CASE DATA*

Date of Culture	B. acidophilus	Caries
Nov. 21, 1927	—	
Dec. 7, 1927	+	
Dec. 20, 1927	—	
Jan. 8, 1928	—	
March 26, 1928	—	
April 16, 1928	—	
June 1, 1928	—	No caries

*Case 25 (girl, aged 8).

TABLE 10.—CASE DATA

Date of Culture	B. acidophilus	Caries
Nov. 10, 1927	—	
Dec. 7, 1927	—	
Jan. 4, 1928	—	
Jan. 18, 1928	—	
Feb. 1, 1928	—	
Feb. 15, 1928	—	
March 23, 1928	—	
April 16, 1928	+	
April 18, 1928	—	
May 4, 1928	—	
June 1, 1928	—	
June 8, 1928	—	No caries

*Case 41 (boy, aged 7).

In Table 1 is listed the number of the patient, the number of treatments each received, the result of the culture taken one week after the last treatment and the extent of dental caries at the end of the experiment.

In each instance, with the exception of Cases 43 and 31, in which the last culture was positive, caries occurred. The records of Cases 43 and 31 show that positive cultures had been obtained two or more times during the course of these studies.

Case 43 (Table 2) was positive for at least three months, and at the end

TABLE 11.—CASE DATA*

Date of Culture	B. acidophilus	Caries
Nov. 10, 1927	—	
Dec. 9, 1927	—	
Jan. 8, 1928	—	
Feb. 3, 1928	—	
May 4, 1928	—	
June 1, 1928	—	No caries

*Case 53 (girl, aged 14).

TABLE 12.—CASE DATA*

Date of Culture	B. acidophilus	Caries
Nov. 10, 1927	—	
Dec. 9, 1927	—	
Jan. 8, 1928	—	
Jan. 20, 1928	—	
Feb. 1, 1928	—	
April 18, 1928	—	
June 11, 1928	—	No caries

*Case 54 (girl, aged 13).

TABLE 13.—CASE DATA*

Date of Culture	B. acidophilus	Caries
Nov. 10, 1927	—	
Dec. 9, 1927	—	
Jan. 8, 1928	—	
Feb. 3, 1928	—	
March 29, 1928	+	
May 4, 1928	—	
June 1, 1928	—	No caries

*Case 55 (boy, aged 13).

TABLE 14.—CASE DATA*

Date of Culture	B. acidophilus	Caries
Nov. 10, 1927	—	
Dec. 9, 1927	—	
Jan. 8, 1928	—	
Feb. 3, 1928	—	
March 29, 1928	—	
May 4, 1928	—	
June 1, 1928	—	No caries

*Case 56 (boy, aged 15).

of that time, three occlusal pits had become carious.

Positive cultures were obtained from Case 31 (Table 3) at two different times.

In Cases 28, 29, 40 and 42 also caries developed. The records are shown in Table 4.

It will be noticed that, in each case, two or more positive cultures were obtained during the period of observation.

Cases 24, 25, 41, 53, 54, 55 and 56 showed no caries at the end of the course of treatments. The records are given in Table 8.

In looking over the tables listed above, one is struck by the transient character of the organism. April 16, for instance, Case 41 was positive, while, April 18, a culture taken from the same case failed to reveal the presence of the organism.

Bacillus acidophilus was recovered from three of the seven children who failed to develop caries. In each of these cases, the organism was recovered only once; whereas, those individuals who finally developed lesions yielded two or more positive cultures during the course of these studies. It is well not to interpret one positive culture as an infallible indication of the approach of dental caries, although, to be sure, it may serve as a warning.

The fact that we were unable to prevent the implantation in the mouth of *B. acidophilus* by the use of metaphen does not mean that the solution is of no anti-acidophilus value. Coincident with the caries prevention experiment, an attempt was made to check the progress of already existent dental caries. A group of practicing dentists agreed to participate in this study, and each selected a few of his most troublesome cases of recurrent caries for anti-acidophilus treatment. Through the cooperation of the Rochester Department of Health, culture mediums were distributed to these dentists. The method of culture was quite similar to the procedure described in the paper previously referred to.[1] A fine point explorer was passed between the anterior and posterior teeth, as well as through occlusal fissures and

pits. The material so collected was shaken off into a tube of 2 per cent glucose-meat infusion broth p_H 5, and sent to this laboratory for examination. It so happened that positive cultures were obtained in all cases of active caries. After taking the culture, the operator proceeded to fill all of the cavities and apply the metaphen treatment on three consecutive days. Another culture was taken one week after the last treatment, and the performance repeated until two consecutive cultures were negative. The patient was then requested to return in one month for a culture. Unfortunately, the prescribed thorough treatment was carried out in but a small minority of the cases; but encouraging results were obtained nevertheless. Particularly in those instances in which the dentist was able to enjoy the whole hearted cooperation of enthusiastic patients, *B. acidophilus* overgrowths were curtailed, and as far as we are able to judge at this time, the occurrence of new cavities was delayed. It is hoped that this work will be continued, solutions other than metaphen being employed also.

CONCLUSIONS

During the course of these studies, it was possible to predict the onset of dental caries by a definite change in the bacterial flora of the mouth, and it does not seem unlikely that stringent anti-acidophilus treatment directed at such a time may do much to save the teeth from caries.

From observations based on a bacteriologic study of a limited number of individuals for a period of over two years, it is our opinion that the occurrence of dental caries is, in every case, preceded by the appearance of *Bacillus acidophilus* in the mouth flora.

It was further observed that the occasional use of metaphen is of little value as a prophylactic measure against the invasion of the mouth by *Bacillus acidophilus*. The rigid use of metaphen is of value in curtailing already existent overgrowths of this organism.

DISCUSSION

Russell W. Bunting, Ann Arbor, Mich.: The work of Dr. Jay has been the most helpful and the most encouraging thing that has come to me in the past few years. When we first took up the study of *Bacillus acidophilus* as the specific cause of dental caries, we begged the bacteriologists over the country to check us up, to find out if what we saw was true. Dr. Jay told you we had obtained a 98 per cent check. We did in the first group, but, in other groups, it did not run so high. As far as I know, Dr. Jay is the only man who has set out to find out whether this observation is true. If anybody else has done it, he has kept very quiet about it, and it has not come to our attention. The work of Dr. Jay has been most helpful, because he has found, in a measure, a corroboration of what we are seeing. If we are wrong we want to know it at once before we have wasted any more time. At present, as far as we see, and as far as Dr. Jay can see, it seems that we are right.

J. H. Thompson, Spokane, Wash.: I should like to know the action of *Bacillus acidophilus* on the enamel and dentin.

Dr. Jay: The chief thing to bear in mind is that *Bacillus acidophilus* is able to break down carbohydrates and form lactic acid. Dr. Bunting, some years ago, was able to produce lesions in teeth experimentally with cultures of *B. acidophilus* in this way: Sterile neutral glucose broth was inoculated with *Bacillus acidophilus* and the tooth inserted in it and left in the culture. In this way, he has been able to detect decalcification. He obtains something very much like the lesion of dental caries. I have done this with sterile lactic acid. The important thing is a solution of the enamel — the calcium in the enamel—by the lactic acid, for that first step. Dr. Bunting says that he has done it through a collodion sack which allows the

acid and not the organism to go through. So the acid there is the chief factor in that case.

F. F. Whitcomb, Omaha, Nebr.: I would like to know whether Dr. Jay paid any attention to the elimination in his cases.

Dr. Jay: No, we were not able to do that. We were fortunate to see the children as often as we did. We did not try to correlate the flora of the intestinal tract with that of the mouth. The aciduric organisms that are found in the mouth, in the intestinal tract and in the vaginal tract are similar, but there may be differences that perhaps will be best detected through serologic study. I do not think we are justified in trying to give them different names until we know more about them.

H. M. Hawkins, Los Angeles, Calif.: Dr. Jay, has there been any work done by you in regard to the concentration of lactic acid produced by *B. acidophilus* as compared with the other coccus forms in the mouth, so that we can see the relative strength of lactic acid produced by each form?

Dr. Jay (closing): We have done a little of that work. We are not trying to gage the p_H, but we find that certain staphylococci will form an acid. Those strains which I have isolated did not produce sufficient acid to decalcify teeth.

POSTOPERATIVE CONSIDERATIONS REGARDING EXTRACTION OF TEETH*

By BOYD S. GARDNER, D.D.S., Rochester, Minn.

IN the simple or in the complicated extraction of teeth, some of the fundamental principles of surgery, as applied in general surgery, should be considered.

Inflammation may be defined as a reaction of tissue to irritation. The causes are chemical, bacterial and traumatic. Obviously, the exodontist should attempt to minimize the causes of this phenomenon.

Undue chemical irritation has accounted for inflammatory conditions which could be avoided. For example, in attempts to sterilize the field of operation in the extraction of teeth, chemical solutions have been used in such strength as to add materially to the uncomfortable postoperative sequelae. Iodin has undoubtedly been the principal offender, as it has been used more freely than any other drug in oral work. It has been found that little if anything is accomplished by its use. Experimentation covering a period of years has demonstrated that it is better not to attempt to sterilize the field of operation unless a chemical can be used which does not contribute to the cause of inflammation. In the experiments, iodin was applied around the teeth on one side of the mouth, and no attempt was made to sterilize the opposite side. After the extraction of teeth on both sides, the results were far more satisfactory on the latter. In this respect, the work of the exodontist can be compared to the work of the surgeon, who has found it im-

*From the Section on Dental Surgery of the Mayo Clinic.

*Read before the Section on Oral Surgery, Exodontia and Anesthesia at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 21, 1928.

practical to attempt to sterilize the mucosa of the stomach and intestine. Socket medication is not used in any form, since irritation and not sterilization is the result. It should be borne in mind that tissue broken down by any type of irritation offers a lowered resistance to infection.

Bacterial irritation is an important factor in the extraction of teeth, but this can be well controlled by adherence to general surgical technic. The dental operator should protect his patient by wearing rubber gloves, face mask and gown. The patient should also be draped to assist the operator in minimizing the possibility of carrying pathogenic bacteria into the oral cavity. The application of 50 per cent alcohol to the part of the face not covered with a sterile towel is of assistance. It should be emphasized that it is necessary to sterilize the instruments immediately before operation, rather than the day before. The dental cabinet should be considered only a storehouse for instruments rather than a surgical table or stand. In other words, instruments that are to be used in extracting teeth should be sterilized and laid out on a sterile towel which rests on a surgical stand or table in order that the operator can reach for his instruments as they are needed, or they can be handed to him by an assistant without touching anything that might not be sterile, such as the door or drawer of a dental cabinet.

The arguments used by many dentists that such cleanliness is not necessary in dental work because it is not possible to sterilize the field of operation are not convincing. It is obvious that, in the extraction of teeth, trauma should be minimized in both soft and osseous tissue. Therefore, instruments should be used that will cause as little trauma to tissues as possible. If it is necessary to retract, and particularly if it is necessary to incise, soft tissue, care should be exercised, as such tissue plays an important part in protecting osseous tissue and aids materially in maintaining blood clots. Cutting instruments should be sharp, and particular attention should be given the blood supply of the soft tissues that are to be retracted. One should not overlook the fact that postoperative results require a study of the postoperative condition of the supporting tissues rather than of the extracted teeth or the osseous tissue which is cut away. Osseous tissue, when cut by a small, sharp chisel driven by the proper blow from a mallet, will show far less trauma than when cut by any other method. In fact, in preparing the ridge for dentures, proper chisels will leave less trauma in the alveolar process than if it is cut out or dressed down by rongeur forceps. Such instruments pinch the tissue before the actual cutting is done, but are used advantageously for certain work.

Postoperative results will be far more satisfactory if more of the supporting osseous tissue than usual is cut away from the more difficult impacted third molars. The use of instruments that require a fulcrum should be minimized, since the part of the osseous tissue which is used as a fulcrum might sometimes cause severe trauma. The injured bone is prone to become infected, and this accounts largely for postoperative discomfort, and particularly that due to trismus. The use of instruments that compress by wedging the bone that is not removed should be discouraged. This type of trauma adds materially to postoperative pain.

The dry socket, from the standpoint of both prevention and treatment, still

occupies an important place in dental literature. Gillis[1] advises against the use of mouth washes for at least twenty-four hours after extraction as they delay coagulation of the blood. If mouth washes are omitted, the blood clot is preserved.

A few years ago, a study was made to determine the possible relation of the dry socket to the general condition of the patient, and any such relationship was ruled out. It was brought out that the patients who had dry sockets were those who sucked the clots from the sockets, and spit often. Accordingly, such a habit is discouraged, and patients are instructed to spit as little as possible for at least twenty-four hours. The act of spitting tends to produce negative pressure, which, in turn, relieves the sockets of clots. It was also found that the sockets most commonly dry were those from which the greatest amount of suction was obtained, namely, bicuspids and first molars in both the maxilla and mandible. The treatment of dry sockets has been varied by different operators. Many methods have been found satisfactory. A suppository has recently been put out by a well known pharmaceutical company that is especially promising. It is easily applied to the socket, and controls pain for a longer period.

The variable opinion of dentists regarding suturing following the extraction of teeth is rather difficult to explain except on the ground that it is a new procedure to most of them. Perhaps some of the failures of the method have been due to the fact that too much is expected of it, and because it has not been carried out properly. For example, the stitches have been placed with so much tension that they cut through the tissues, or too many have been used, thus causing additional trauma, and correspondingly unsatisfactory results. Incorrect suture material and needles may also be the cause of dissatisfaction. Notwithstanding the objection to suturing, many operators have improved their postoperative results in this manner, and an effort should be made by teachers of undergraduates in dentistry to standardize its use. Suturing is not always indicated after the extraction of even an impacted third molar, but when it is indicated, it should be used. The socket should be entirely closed in every extraction; another point not definitely understood.

The number of teeth extracted at one time may have an important bearing on postoperative conditions.[2] I have been able to secure complete histories of all patients operated on in the Mayo Clinic, and by charting conditions postoperatively, have accumulated data that emphasize the significance of discontinuing the practice of extracting all diseased teeth at one time. Results are more satisfactory if the operation is performed in two or more steps, a few days or a week apart, the interval depending on the patient's reaction.

Patients who are acutely ill should be put to bed and treated medically before extraction of the infected teeth is attempted. Symptoms should be carefully observed and examinations made to avoid mistakes in diagnosis. Pain in the region of the mandibular third molar, with swelling, trismus and fever, does not always indicate that the cause is an impacted or unerupted tooth, even though the roentgenograms reveal such a condition. A diagnosis of actinomycosis is

1. Gillis, R. R.: Personal communication to author.

2. Gardner, B. S.: Extraction of Teeth: Amount of Surgery Feasible at One Time, and Treatment of Acute Cases, Dent. Cosmos, 67:661-663 (July) 1925.

often made, if such symptoms are present.

A dressing is seldom used after the extraction of any tooth. But if a dressing such as iodoform gauze is used, it should not be disturbed for at least a week, which is contrary to the usual practice of changing daily.

Ice packs are applied directly after extraction and continued for at least five or six hours. Clots are not disturbed because of pain. Patients are given relief by the use of sedatives and opiates, if necessary. Bowel elimination is very important.

Heat is applied rather than ice packs, in cases in which marked swelling with trismus, cellulitis, etc., develop. The heat is applied intra-orally in the form of hot water, introduced by a rubber tube from some form of an elevated irrigation receptacle, and extra-orally by hot water bags or electric pads. This form of treatment is continued until drainage is established.

Although local postoperative conditions are not affected materially by different anesthetics, it is quite obvious that, by the use of block anethesia, better local results can be obtained, and more easily, in the majority of cases in which difficult extractions are to be made. This anesthesia, therefore, is used for most adult patients in the Mayo Clinic in preference to any induced by a general anesthetic.

It is understood that many patients are referred to the exodontist who is willing to make use of a general anesthetic and employ a certain technic of extraction. However, patients want the best service that can be given them, and if they understand that the operator can work to a better advantage, especially in the more difficult extractions, under local anesthesia, and can control pain, they are willing to have it used.

On the other hand, many patients refuse to allow a tooth to be removed without the use of nitrous oxid, and dentists are prone to meet such a demand. But if the extraction of teeth is to be placed on the same plane as is general surgery, the general surgeon must be copied rather than the barber who cuts the hair the way the customer wishes.

From the standpoint of postoperative service, the roentgenogram made directly after operation is outstanding in its importance.[3] If it shows that all roots have been removed, the patient will be more tolerant of any discomfort that may follow. I have used this procedure as a routine for many years and feel that I have proved its importance. A roentgenogram that reveals that the leg or arm is properly set, or one that reveals satisfactory extraction of a tooth, is a comfort to the patient, physician and dentist.

If it were general practice among those who extract teeth to make daily records of postoperative conditions, treatment following such operations would become standardized. Valuable postoperative information can be obtained if the operator visits patients who are not in condition to report to the office after the extraction. Unless such data can be obtained, it will be difficult to determine the best technic of extraction, and the best anesthetic to administer.

As emphasized by Ward,[4] Vastine[5] and others, the insertion of dentures im-

3. Gardner, B. S.: Postoperative X-Ray Examination in Dentistry, Radiology, 3:74-75 (July) 1924.

4. Ward, A. W.: Personal communication to author.

5. Vastine, A. B.: Personal communication to author.

mediately after extraction is another important procedure. The dentures act as splints, and because of the protection and resistance they afford, better and quicker repair takes place. Ward has made use of his surgical cement to line plates; which insures a fit and adds to the patient's comfort. He recommends that the denture be relined with this cement every ten days, at least three times, and then it can be rebased permanently by vulcanite.

Many dentists have considered the curettement of sockets, the reduction of the alveolar process and the immediate denture construction as new procedures. In a review of dental literature, it has been found that these are merely old ideas with but little refinement. Gillis has lately called my attention to early publications as follows:

After extracting the teeth, I clip off all the mucous tissue that filled the space between the necks of the teeth, leaving a smooth border. I then dissect back the fibrous-mucous tissue from the alveolar wall or border about one-fourth of an inch and cut off with a pair of bone forceps the alveolar edge from a fourth to three-eighths of an inch deep; this will allow the edges of the mucous tissue to come together having the appearance of a cut only around the dental arch. In the cases I have thus far prepared this way, I believe I have saved the patients much inflammation and suffering, and also nature the task of removing this same matter by absorption or effusion. By this process, we, in a measure, destroy the mucous excretory follicles around the dental border and thereby they sooner become hard and firm. We shall save the risk of having detached pieces of bone in the gums, to find their way out by abscess or absorption. We shall save the patient most of the disagreeable effects of the effluence from the gums; we can save four months' time in fitting the gums of patients for a permanent set of teeth, and not least, in a pecuniary view of the subject, we have better shaped mouths and consequently more easily fitted and handsomer work can be done.

But the difference in age, health and number of teeth to be removed should be the criterion for our government under this operation. I offer these remarks for what they may be worth and hope to hear from some of our able dentists on this or any other mode of preparing the mouth for sets of teeth.[6]

In such a case, the sac will nearly always be retained in the alveolus after the tooth or root is removed; the abscess now acts independent of the cause which produced it, and the extraction of the tooth will rarely effect a cure. An operation for the removal of the abscess will be necessary. This may be done by chiselling or scraping off all dead particles of bone in and about the cavity.[7]

It is obvious that antiseptic postoperative treatment is indicated if aseptic surgery is not practiced, but it is hoped that the time is not far distant when, by the help of dental colleges and teachers of graduate students in this specialty, the extraction of teeth will be placed on a plane with general surgery.

DISCUSSION

Earle H. Thomas, Chicago, Ill.: In the first paragraph of this paper is the statement that, in the extraction of teeth, some of the fundamental principles of surgery, as applied in general surgery, should be considered. Possibly Dr. Gardner did not wish to appear too emphatic, but I think he will agree with me that *all* of the fundamental principles of surgery must be considered, because the removal of any tooth is a surgical operation. Nature's reaction is the same to all surgical operations on similar tissues, and like responsibilities rest upon the shoulders of the operator. Life itself may be involved in many instances. I agree that much postoperative discomfort is often caused by attempts at sterilzing the field of operation and that any agent used for this purpose must be one that does not cause inflammation, but I would not recommend

6. Willard, A. T.: Articles in Dental News Letter, Vol. 6, 1852.

7. Shadoan, W. H.: Alveolar Abscess, Dent. Reg., 22:418, 1868.

the elimination of this phase of the technic. Even though the saliva undoubtely keeps all surface bacteria in an attenuated state, I have always considered that an agent on the order of acriviolet, applied around the gingival crevice and over the site of hypodermic injections, offered us a little more protection by further attenuating the bacteria. However, there is one place and one time that I never use medication of any kind, all recommendations in the literature regarding proprietary preparations to the contrary notwithstanding, and that is in the socket immediately after the removal of a tooth. Of course it is impossible, in the mouth, to sterilize the field of operation, but it is undeniable that the nearer we approach an aseptic technic, the less will be the postoperative reaction. From a practical standpoint, it does not seem possible for the majority of us to observe the routine along this line that is followed by Dr. Gardner, but there is no question that many of us fall too far short of the ideal. The main principles that suggest themselves to me along this line are as follows: (1) to be certain that all instruments are thoroughly sterilized between cases, as the main danger lies in bacteria from this source; (2) never to allow the operating surfaces of instruments to come in contact with anything but the field of operation, and (3) once the tissues are opened into, not to allow saliva in that area until the site of operation is closed or covered by blood clot. I agree that trauma should be minimized in both soft and osseous tissue, because such traumatized tissue is very prone to infection. This is one of the most important phases of the technic of any operation. I would not criticize the use of any type of instrument or any particular technic provided the instrument was used, or the technic carried out, in a skilful manner. An important cause of trauma is the exposure of the osseous structures to air over a long period of time, especially when under the effect of epinephrin. I must emphasize the importance of giving particular attention to the blood supply of the soft tissues when deciding on the location of incisions. It requires close study and considerable experience to judge in each individual case just where to release an impacted tooth and how much bone should be removed. Unquestionably, considerable trauma and resulting postoperative discomfort are the result of faulty procedure in this respect. Dr. Gardner mentions the prevalence of so-called dry sockets, and I would like to here enumerate some of the conditions to be considered as having a tendency to cause such a condition: 1. Use of nonsterile instruments. 2. Presence of saliva in the socket before the blood clot is formed. 3. Any instrumentation in the socket. 4. Presence of sclerotic bone, with restricted blood supply, lining socket. 5. Excessive leverage by forceps or elevators; and I would like to here call attention to the fact that forceps involve fulcrum and leverage effect every bit as much as does an elevator. 6. Exposure of socket to air an unreasonable length of time. 7. Use of epinephrin of excessive strength in a local anesthetic. 8. Virulent infection from the apical region. 9. Old age of patient. 10. Medicating the socket before the blood clot forms, or washing out the mouth before the blood clot is formed. 11. Leaving a gauze drain in the socket. 12. Suction on, or placing the tongue or finger in, the socket, by the patient. It is my opinion that, after the blood clots in the socket, mouth washes may be used to any extent without danger of washing out the clot. It is decomposition of the clot that results in a dry socket, and this usually takes at least forty-eight hours. I agree that there are many satisfactory methods of relieving pain in this condition, and the principle of the treatment is to keep the exposed bone protected from saliva and air until Nature has covered it with granulation tissue. To cause further trauma by a curettement of the surface of this exposed bone appears to be illogical. Regarding suturing following extraction, I can only say this: If one has not surgical judgment, he should not attempt these operations. I sometimes perform an alveolectomy in the maxilla without placing one suture and at times I place two or three sutures after the removal of one single-rooted tooth. I most certainly agree that it is unwise to remove a large number of infected teeth at one time, especially when the patient has some serious general trouble. Of course, thirty-two diseased teeth have often been removed in one operation without serious reaction; but why take chances when life is involved? We are supposed to be doctors, you know. In

deciding on the type of anesthetic to be used, three factors should be considered: (1) the condition of the patient; (2) the type of operation, and (3) the ability of the operator to follow a careful and efficient operative technic in the particular case under the chosen anesthetic. No operator worthy of the name allows dictation. Dr. Gardner voiced the hope that the time is not far distant when the extraction of teeth will be placed on a plane with general surgery. He mentioned two conditions that would bring this about, but he failed to include what, to my mind, is possibly another important factor in hastening that day. The public by sad experiences are realizing, faster than a certain proportion of dentists, that the extraction of a tooth is a surgical operation, and they are demanding the results obtainable only by following correct surgical principles.

George Schneider, La Salle, Ill.: If, in removing a tooth, the entire soft tissue lying between the root and the alveolus should be removed, would not that cause a dry socket?

H. J. Schwarz, St. Louis, Mo.: What medical term could be substituted for the term "dry socket"? What is the nature of the bone as distinguished from a wet socket?

Eugene Schmitt, Chicago, Ill.: I should like to have Dr. Gardner's opinion as to whether, after a blood clot has organized, a nonacid mouth wash will tend to disturb the blood clot and break it down so that it will clot over.

G. R. Bruce, Columbus Junction, Iowa: Is there a pathologic condition that causes dry socket? There are many of us, I know, who have taken out teeth and they come out as a nail comes out of a board, with no sign of a clot.

C. E. Brown, Lincoln, Nebr.: In checking up on postoperative pain in cases of full mouth operation, what is the percentage of pain? Is it greater with nitrous oxid, or with local or block anesthesia?

H. A. Elmquist, Des Moines, Iowa: I disagree with one point Dr. Gardner made, that is, if we don't operate aseptically, we should use an antiseptic. I think the same objection to using an antiseptic at all would apply in double measure, if we are not aseptic in our technic. We need to conserve the combative ability of the tissue, and if the antiseptic in the socket militates against this combative faculty, the more antiseptic we use, the more we need to conserve that combative ability.

Dr. Gardner (closing): The majority of dentists practice antiseptic surgery rather than aseptic surgery. It is apparent that they have not kept pace with the progress that has been made in general surgery, and I believe that they would benefit by recognizing the advantage that the one has over the other. I do not believe that we have any more postoperative pain from procain block than from a general anesthetic. This answer should be supplemented by emphasizing the necessity of utilizing the same precautions in the operating room as are used by the general surgeon. It is obvious that many operators with their quick work cause less postoperative pain by using a general anesthetic. The percentage of roots left is far less and results in general are better when block anesthesia is used. But, with block anesthesia, more attention must be paid to the operating room sepsis and the application of surgical principles, as more time is consumed and there is more manipulation of tissue. I do not believe that the general condition of the patient is a causative factor in dry sockets, and there are many different types of treatment for this painful condition. The important point to consider is prevention. By elimination of the mouth wash for twenty-four hours and advice to the patients to spit as little as possible for some length of time, the clots are more apt to be maintained and dry sockets minimized. It is our opinion that we have far less dry sockets since the improved methods of extraction have been in use. No doubt, this is due largely to the fact that trauma is minimized. In third molar work, we find that there is far less postoperative pain when these difficult teeth are better prepared for removal by cutting away more of the supporting osseous structure. This minimizes the use of levers. It should be borne in mind that, when levers are used, the same pressure is exerted on the fulcrum as is applied to the tooth to be removed. There will be much less trauma when sharp chisels driven by correct blows from suitable mallets are used than when the process is

cut by revolving instruments such as drills and burs. Better results would be obtained in difficult extractions if patients were allowed to remain in bed, whether in the hospital or at home for at least two days after the operation. The large percentage of dentists are not recognizing this, asking their patients to report to their offices daily until dismissed. If they would make calls as is the practice of physicians, the surgical aspect of dentistry would be put on a much higher plane. I do not refer to all patients for whom teeth have been extracted, but to those for whom difficult extractions have been performed and to those whose systemic condition warrants better care.

FURTHER PROGRESS AND OBSERVATIONS IN THE TREATMENT OF MALOCCLUSION INVOLVING SPACES*

By HUGH GRUN TANZEY, D.D.S., Kansas City, Mo.

EVERY dentist is from time to time confronted with the problem of deciding what to do about malocclusion cases presenting such symptoms as spaces between central incisors where there is an abnormal frenum labium; or spaces where there are one or more teeth congenitally missing (Figs. 1-4); spaces resulting directly from the extraction of teeth, or spaces caused by unerupted or impacted teeth; by excessive overbite, by pathologic conditions, trauma anomalies of size or various other contributing causes. It will not, of course, be possible to more than mention the majority of these ailments in passing. Probably no other form of malocclusion is more disconcerting to the adult patient or to the parent of the child than those here mentioned. Aside from the small percentage of dentists who have been misguided into the belief that tooth movement in all cases is easily and quickly effected if only the proper means are employed, and the smaller percentage of dentists who will take the time and precaution to go into a detailed analysis of the case before attempting to treat it, there is a larger group of more or less misinformed, disappointed dentists who have essayed to "improve the situation" by the all too common rubber band method, or by ligating teeth together or wedging them apart, then bridging the space with some sort of restoration. In many instances, part or all of teeth have been sacrificed previous to the unsuccessful attempt to restore acceptable esthetic and sanitary conditions.

There is hope that eventually dentists will assume the responsibility of advising in all such complicated cases that the patient investigate carefully before starting wildcat methods of correction. One point that I desire to emphasize more than all others is that teeth may move readily on the application of force, but, in the majority of cases, it requires a much longer time to effect that nice final adjustment, and to complete the case with anything like assurance of ultimate

*Paper read before the Section on Operative Dentistry, Materia Medica and Therapeutics at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 22, 1928.

success requires skill and strategy possessed by the adept and boasted by the few.

It is quite true the dentist, and likewise the orthodontist, are often asked, each by the other, to do the impossible, but, with proper cooperation, a happier medium may be worked out that will please the patient, who is, after all, most concerned. It is quite possible that the general practitioner entertains the altogether erroneous idea that an orthodontist can accomplish the almost impossible and do it in a remarkably brief time. It is reasonable to assume that the orthodontists, or at least some orthodontists, who have, with almost infant-like abandon, and with an almost pardonable self-admiration, displayed spectacular cases wherein they have surprised themselves with their own astonishing achievements, have been directly instrumental in bringing about this undesirable state of affairs. Should orthodontists combine in some gigantic move to expose all of the cases in which surprisingly meager results have been obtained with the profoundest effort and consideration of which they are capable, the consensus of opinion might be reversed. Nothing short of catastrophe will convince a hard headed dentist against his will that he cannot do it, and do it better in less time for smaller compensation than can the experienced veteran with many failures and some successes checked to his credit.

Fig. 1 (Case 1).—Patient, aged 18, presenting congenital absence of maxillary lateral incisors

To get back to the spaces: It is an undisputed fact that practically all spaces regardless of shape or size are either too large or too small. To dispose of these obnoxious spaces, it is necessary to readjust, rearrange and perhaps disarrange the ensemble. As orthodontists, it is our business, our duty, and should be our aim, to consider carefully and to advise in all cases of irregularities of the teeth no matter what the age, extent or extenuating circumstances. In our attempt to correct, prevent or improve cases, we have undoubtedly been considerably delayed by unexpected detours in the course of treatment. (Figs. 5-9.)

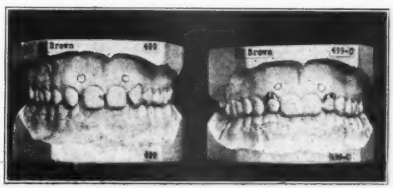


Fig. 2 (Case 1).—Left: Casts showing typical spaces resulting from congenital absence of maxillary lateral incisors. Right: Casts at close of treatment extending through a period of eighteen months, during which time all maxillary teeth were assembled toward the median line.

I believe that it will be possible to eliminate much of this delay in the future if some other obstinate or extenuating circumstances do not arise. It should be well understood in the beginning that any plan of procedure will be a compromise, and any attempt to obtain ideal results will certainly end in

disappointment. On the other hand, astonishing results may be obtained in both adult and junior cases. It would appear much easier (and probably is) to move a given tooth forward than

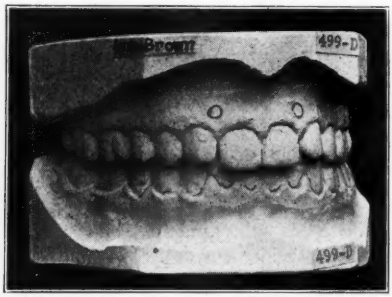


Fig. 3 (Case 1).—Casts showing condition present twenty-four months after treatment was discontinued. The third molars are all in good relation. The cuspids were reshaped to resemble lateral incisors. Active postoperative maintenance was employed for eleven months. At the close of active treatment, carborundum paste was freely used in an effort to establish facets on occlusal cusps.

Fig. 4 (Case 1).—Patient, aged 22, twenty-four months subsequent to cessation of all treatment, which comprehended closing spaces caused by congenital absence of the lateral incisors and the readjustment of all mandibular teeth.

backward, and to move a tooth either direction subsequently to the extraction of an adjacent tooth. I am a bit dubious still as to just how much backward movement should be attempted except in those cases in which there has been unquestionable forward displacement of the offending tooth. My efforts have been confined largely to the forward or mesial movement of teeth. Edifying results have been obtained in numerous cases in which the first permanent molars were extracted and the second molars, if erupted, were moved forward to assume

Fig. 5 (Case 2).—Left: Original casts of patient, aged 17. After two years of unsuccessful treatment, a different orthodontist recommended extraction of the mandibular first molars (both pulpless) and moving the second molars forward to close the spaces. This it was correctly assumed, would permit the partially impacted third molars to erupt in the position then occupied by the second molars. After the elimination of the left first molar the patient refused to have the first molar on the opposite side extracted until it had been demonstrated to her satisfaction that it was the proper procedure. This required about one year. The other tooth was then extracted and automatically another year was added to the period of treatment. Right: Casts made after treatment.

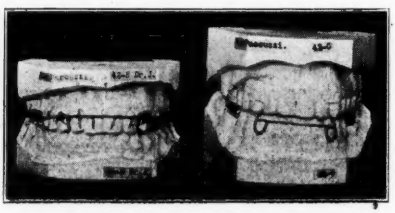


Fig 6 (Case 2).—Left: Intermediate treatment appliance. Right: Last appliance employed in active postoperative maintenance.

the position of the lost tooth. When the second molar was unerupted, naturally unavoidable delays were experienced, and other phases of the treatment were also affected and usually retarded. (Figs. 10-11.)

I have been surprised to note that the occlusal harmony may be preserved or restored, which indicates the bodily forward movement of the teeth. The condition of the gingivae approximating these teeth is apparently satisfactory in the majority of cases. The roentgen-ray, of course, exposes any improper adjustment of the roots of teeth rearranged, and often presents mute evidence of unsatisfactory results and of ill advised attempts at correction. One of the most puzzling conditions yet confronted is the frequency of root absorption in connection with orthodontic treatment and the questionable causes therefor. This phenomenon is likely to show up at the most inopportune time and when least expected, and, in many instances, without obvious provocation. As to what extent this condition is detrimental or irreparable, I am in no position to estimate. In one case recently treated, we found considerable root absorption in the maxilla while we were closing a space on one side of the mandible. (Fig. 12.)

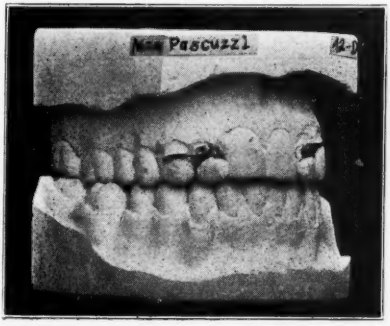


Fig. 7 (Case 2).—Casts showing condition eleven months after treatment was discontinued. Carborundum paste was freely used on the occlusal surfaces.

Evidently the condition could not be ascribed to the type of appliance. The patient was one of the most robust under our care. There were other pathologic symptoms that might throw some light on the question if investigation were followed out. Time may prove that we have overestimated the value of results obtained in the closing of spaces. If, on the other hand, we should be awarded the decision, we can see in the offing a great demand for skilled orthodontists who are willing to volunteer services in the field of adult orthodontic endeavor. In any event, it is a mark of distinction to be able to decide what one deems the best method of procedure in many of these cases. The question of anchorage, direction of forces and strategy of attack demands the most tactful consideration, and the designing of appliances different in many particulars from the routine appliance affords further fascination. My efforts shall in the future be accompanied by the keenest sort of interest in any intelligent analysis of the evidence pro and con in closing

Fig. 8 (Case 2).—Patient after a protracted treatment period of eight years.

spaces, or any other conception of our duty toward patients presenting this particular type of malocclusion.

DISCUSSION

J. W. Ford, Chicago, Ill.: Much has been written on this subject, with some difference of opinion, but, from a clinical observation, I do not recall any one's work that has been more successful than Dr. Tanzey's, including not only cases of single rooted teeth but many multirooted cases of older patients. As the public is gradually taking more interest in the care of the teeth, more such cases are being brought to our attention and, likewise, greater demands are being made on our judgment and skill in diagnosis, prognosis and treatment. Of most importance in the consideration of any such case is thorough understanding and cooperation between the operator and the orthodontist. Much can be accomplished toward such an understanding, in the patient's absence, by the use of study models and full mouth roentgenograms. The general condition of the teeth and of the soft tissues of the mouth and the physical condition of the patient are of first consideration. A plan which was first suggested to me by Dr. Lourie of cutting off the plaster teeth of these study models at the gingival margin and rearranging them in wax on the model is of great assistance. As has been said, almost any plan of procedure, especially when teeth are missing, will be a compromise. To quote Dr. Tanzey: "Many cases have been considerably delayed by unexpected detours in the course of treatment"; which the orthodontist fully appreciates. This statement prompts us to consider the temperament of the patient, as to whether we can expect one hundred per cent cooperation over the extended period of time always necessary.

I wish to emphasize what Dr. Tanzey has said regarding our great interest in this particular work in our specialty. While the demands are most trying and exacting, the conscientious and skilful orthodontist can be depended on to do his utmost for the good of all concerned.

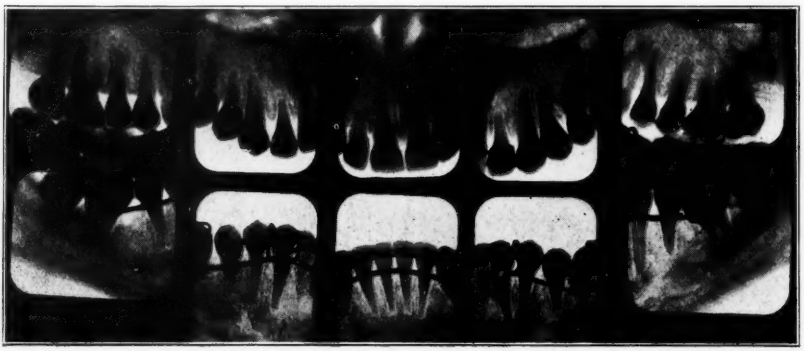


Fig. 9 (Case 2).—Roentgenogram taken at the conclusion of eight years of active treatment.

Abram Hoffman, Buffalo, N. Y.: The closing of spaces is as interesting to the uninitiated as it is disconcerting to the experienced orthodontist. The problem of closing spaces seems simple enough in many cases, but, in reality, the ultimate result is apt to be like a boomerang—the condition is quite sure to return, unless the operator has had a full understanding of the causes, and of the fundamentals of occlusion. The forces of mastication must be appreciated and brought to such a state of perfection and coordination as to insure not only the retention of a moved tooth, but also the avoidance of traumatism and its sequelae. I am interested in the term "wild-cat meth-

ods." It is quite expressive when we consider the state of the dental tissues after an encounter with rubber bands, threads, crude appliances and the like, such as are all too frequently used on helpless children in the effort to close the characteristic space between upper central incisors when, perhaps, the mischievous factor has been an excessive overbite or something equally remote from the space itself, but not so readily seen by the untrained eye. It is more than probable that it is necessary to readjust, rearrange and maybe disarrange the ensemble as has been stated, but, first of all, the cause must be determined. Dr. Tanzey very properly says that, as orthodontists, it is our business, our duty and should be our aim to advise, in all cases of irregularities of the teeth, no matter what the age, extent or extenuating circumstances may be. I will go further and say that it is the duty of any or all dentists, not orthodontists alone, to appraise patients of the existing conditions and the probable consequences. Many of us are indifferent or thoughtless in these matters, and it is an unpleasant experience to have a parent say, "I don't understand why Dr. Blank never told me these things. I have taken my children to him regularly for years for his care and now I find he has let this terrible condition develop right under his observation." Dr. Tanzey has quite wisely said but little on the subject of the treatment of these cases. I say quite wisely, because we could discuss the subject for hours and still not arrive at a concrete answer that would satisfy more than one or two persons in this audience. Specialists have discussed these matters in their meetings for years, and the most apt summation of it all is that each case is a law unto itself, and individually calls for mature

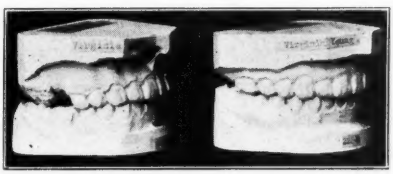


Fig. 10 (Case 3).—Left: Casts taken subsequently to the extraction of the maxillary first molars. Right: Second molars moved forward to close spaces. After intermittent treatment and rest over a period of seven years and repeated unsuccessful attempts at postoperative maintenance, roentgenograms revealed the fact there were maxillary third molars but no mandibular third molars. Owing to numerous fillings and imperfect enamel, the maxillary first molars were condemned and extracted, after which one year was consumed in closing the spaces.

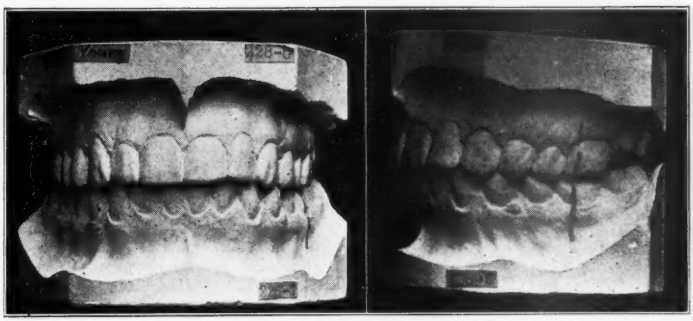


Fig. 11 (Case 3).—Casts taken thirty-two months after treatment was discontinued, ten years after treatment was instituted, showing an admirable adaptation of all teeth, and the maxillary left third molar erupting in desirable position. Roentgenograms in this case reveal no perceptible root absorption.

judgment as to the mode of treatment, the desired esthetic result, the permanency of result and the resulting functional efficiency. With his statement that it is easiest and probably better to move the teeth forward or mesially, which is to say toward the median line as a basic principle, I am in accord. In most instances, that is my custom and it is unquestionably better in the so-called junior cases to have any spaces that may remain after treatment in the posterior parts of the denture rather than in the front of the mouth. Then, too, I cannot quite reconcile myself to the thought of preserving or creating spaces and substituting some restoration to be worn for the remaining years of a child's life. Taken pro and con, this is a broad subject; there were a dozen or more causes or conditions mentioned in the opening paragraph of the paper and this is but a partial list. The interested person consulting the "Index to Dental Periodical Literature" will find listed therein much "for reading during long winter evenings." I venture the remark that he will still be just as far from a "rule of thumb" as are those of us who have devoted many years to the study and practice of orthodontia. It is the efforts such as Dr. Tanzey is putting into this study that are bringing dentistry nearer the coveted goal. There is room in the field of orthodontia for many more practitioners who are willing to prepare themselves and to cope with our perplexing problems and they may then render a real service to humanity and to this beneficent art.

Dr. Tanzey (closing): As Dr. Hoffman emphasized, not only is the orthodontist under obligation to go into these cases for diagnosis, for the satisfaction of the patient, and for the sake of humanity, but the dentist also is under obligation to cooperate with members of the medical fraternity and with the orthodontist. Our children are going to be concerned in this in the future, and I believe now, after twenty-five or thirty years' experience, and about fifteen years in this line of investigation, that I can do the work quickly, more easily and probably better than before. The problem of absorption comes up now: where is it going to lead?

Fig. 12 (Case 4).—Roentgenograms taken at the close of an unavoidable prolonged attempt to correct a complicated malocclusion involving the extraction of the mandibular left first molar in a patient, aged 17. Intermittent treatment and rest continued over a period of four and one-half years.

PRESENT STATUS OF THE ONE-PIECE CASTING FOR PARTIAL DENTURES*

By F. E. ROACH, D.D.S., Chicago, Ill.

THE ever-increasing interest in partial dentures of the removable type may be attributed to the fact that more satisfactory restorations can be made today, and with less difficulty, than in former years. The casting process, the availability of better materials and equipment, an improved technic, the use of the all-gold one-piece casting and a more comprehensive knowledge of the engineering principles involved in design and construction are the factors governing this condition.

The term all-gold one-piece casting was originally used to designate those castings in which the entire metal construction—clasps, saddles, bars, floor and pins for pontics—were cast in one piece; the pontics, of course, being porcelain.

In 1921, I read a paper before the Section on Partial Denture Prosthesis of the American Dental Association in which I used the term "one-piece" casting, to distinguish the casting from the assembled construction. At that time, there were few one-piece castings being made. Most operators were assembling and soldering these parts together.

As far back as 1909, I made some large bilateral castings in one piece, but owing to the deficiencies of investment materials and the lack of casting equipment, I did not recommend the adoption of the one-piece casting at that time.

In 1917, I began the very general use of the one-piece casting. I have continued to improve and extend its application to the making of partial dentures, and after many years of practical experience in the construction of hundreds of cases, I can unqualifiedly recommend this procedure.

The advantages of the all-gold one-piece casting are many, among them being simplicity of construction, greater ease and accuracy in fitting, saving of time, greater variation of design, freedom from soldered joints, need of but one sitting for impression and one for installation, direct casting to the model and the securing of a replica of the mouth conditions in a hard refractory investment compound, which enables the dentist or technician to make accurate survey and thereby predetermine installation and service and maintenance problems, and to simplify the designing of the appliance.

The all-gold one-piece casting is very durable and highly sanitary. It is of all materials, except platinum and porcelain, the most compatible to the tissues of the mouth. It also has greater intrinsic salvage value, and, last but not least, the psychologic effect on both producer and possessor is good.

*Read before the Section on Partial Denture Prosthesis at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 22, 1928.

The essentials in producing satisfactory results are: study models; proper preparation of teeth and mouth; the taking of accurate sectional impressions; use of a hard refractory investment compound, a high-grade casting gold and a good heating and casting equipment, and a comprehensive knowledge of design and the engineering problems in general.

The point at issue in the whole problem is the effect of shrinkage of the gold in passing from the molten to the solid state. It is a well-known fact that all metals undergo dimensional changes when subjected to variations of temperature, and the greater these variations of temperature, the greater the variation of dimension. But as far as dental castings of high-grade gold are concerned, the effect of shrinkage is negligible. I do not mean by this statement that we are overcoming shrinkage, but I do know that, for all practical purposes, we are compensating for it. There are other things that are of equal if not greater importance as governing factors in the discrepancies that occur: The kind of impressions, the character of investment and its manipulation, the method of heating preparatory to casting and the means for melting the gold and making the casting must also be considered.

We have heard the following objections to the one-piece casting: On account of shrinkage, they do not fit. They cause both decay and abrasion of the teeth. The clasps are too soft or too brittle or they are too rigid. The percentage of failures in casting is too great. Taking impressions of these large complicated cases is too difficult. The clasp prevents functional movement of the teeth or acts as a regulating appliance.

To these objections, I would submit the following: As to shrinkage, I have already stated that its effect is negligible, and I am prepared to prove it to anyone who may be in doubt. We might discuss this question to the end of time and not settle it. The fact that thousands of these all-gold one-piece castings are being worn today with more comfort and greater satisfaction than are the cases made by other methods is the best proof of their accuracy of adaptation and their compliance with all of the other requirements of a substitute for the natural organs. My proposition is that, in the average case in the hands of the average dentist, if made according to our present knowledge of the engineering principles involved in design and construction, better results will obtain than from any other method.

Decay and abrasion of the enamel of a tooth under the clasps that we have been using for the past five or six years are practically impossible. I refer now to the bar clasp which constitutes the clasp part of most of my one-piece castings today. The bar clasp, when properly designed and constructed, meets the objections regarding decay, abrasion and rigidity fully.

When a high-grade gold is used and due care is exercised in making the casting, there should be no trouble with soft or brittle castings. Standardized methods of heat treatment or tempering make it possible for us to produce hard or soft castings at will, provided the gold has not been contaminated with a base metal or other foreign matter.

In this connection, may I emphasize the importance of great care and suggest some of the most common causes of brittleness. The prevention of oxidation of the copper, which is a necessary constit-

uent of practically all of our denture casting golds, is difficult, if not quite impossible. By the use of a reducing flame, a reducing flux and quick melting, we can prevent oxidation to such an extent that it is not a serious menace.

Other sources of contamination are: impurities in the investment compound and rust from the compressed air line melting in a crucible previously used in melting some base metal or substance of a detrimental nature. The repeated use of excess buttons is very questionable, and, in all cases, they should be thoroughly cleaned and an equal amount of new gold added. Under no circumstances should scrap of an unknown character be used in making large one-piece castings. The risk is too great. Such a practice may be permissible in inlays or other small castings but not when there is so much at stake. Failures in castings are rare when a standardized technic is followed. Simplified sectional impression methods have greatly reduced impression difficulties.

I can conceive of no more nearly ideal condition for individual functional movement of the teeth than exists when the bar clasp is used as a means of anchorage. It does not interfere in the least with normal movement, nor does it act as a regulating appliance. Quite the contrary. The bar clasp, by reason of its small three point, compensating, reciprocal bearing on the tooth, permits perfect freedom of movement in every direction, and at the same time affords a secure means of retaining the appliance in position.

The bar clasp was not designed to meet these requirements, but as it does so, I merely mention this feature to satisfy those who have become prejudiced against clasps because of this possible defect found in the old type of clasp that grips the tooth with a continuous buccal and lingual bearing.

While the advocates of the precision type of attachment are promiscuously condemning the clasp denture, they have not yet supplied us with a substitute that compares with it in practice. The damage to the teeth in preparation for an anchorage of these attachments in many instances is greater than that which results from wearing a properly designed clasp denture for many years.

For the benefit of the young men in the profession, I would offer a word of caution regarding the adoption of any form of attachment that requires cutting into the tooth for its installation. In my opinion, the precision attachment has been proportionately the direct cause of the destruction of more teeth than has clasps.

That the clasp denture can be made to comply with all of the requirements of conservation, service and efficiency, there can be no doubt. On the other hand, there is no question that the precision attachment can be made to serve equally well. There is a place for both methods. Let us be eclectic, selecting the one best suited to the case in hand and thereby serving our patients to the best advantage.

The one-piece casting is limited only to cases in which the difficulties in securing a correct impression preclude its employment. Sectional construction permits the building of such cases in units and thereby simplifying impression taking.

If there is any one outstanding shortcoming in the practice of dentistry, it is the taking of impressions for partial dentures.

Again, I wish to emphasize the importance of accurate impressions in making the all-gold one-piece casting, and in view of the fact that the principal cause of ill-fitting partial dentures is faulty impressions rather than dimensional changes in casting, it behooves us, as a profession, to correct this very apparent defect in our practice.

Much has been written on the manipulation of wax, the mixing of investment compounds, wax elimination and the methods of melting and casting, but, unfortunately, most writers have had in mind the making of inlays and not partial dentures. It must be borne in mind that the technic for one does not necessarily apply to the other. As a matter of fact, conditions and requirements are quite different; for example, the wax pattern for an inlay is usually fitted to the cavity in the mouth or to a model and then transferred to the investment. I do not need to call your attention to the dangers of distortion that surround this step in the production of an inlay. Since our wax pattern for a cast partial is fitted, sealed and invested directly to the model, no such danger of distortion exists. It is very generally conceded that inlays can be cast in either a hot or a cold mold, but, in the case of partial dentures, the consensus of opinion favors the high heat technic.

While the spruing and the manner of investing are important in inlay technic, they are of much greater importance in partial denture work. The sprues for partial dentures should be attached to the areas of greatest bulk. Under no circumstances should a sprue be attached to wax which represents the clasp, unless the sprue is much smaller than the clasp pattern, for the reason that the gold, when congealing, shrinks to the mass centers, and should there be bulk, such as the saddle on one side of clasp and the excess button on the other, the shrinkage to these two common mass of the clasp, many times to such an excenters will invariably cause weakening tent that the clasp is easily broken and so is worthless. This one mistake in spruing is the cause of many defects in castings.

In melting the gold for an inlay, the danger of damage is not so great, nor are the requirements of the finished casting too exacting; hence, the need for great care in melting the gold does not obtain to the same extent that it does in clasp denture cases. The larger mass to be melted requires more heat and longer time. With the greater copper content of the alloy, danger of oxidation is greatly increased; and when the oxids are deposited in the clasps or bars of a case, their presence obviously is accentuated because of the stress brought to bear on these parts.

Both inlay and partial denture can be successfully cast, with the so-called pressure machines, but centrifugal force is most concentrated and direct, is quicker and does not tend to chill the gold. My preference is for the vertical centrifugal force, with the crucible of fire clay anchored as an integral part of the investment and positioned in a horizontal relation to the mold, so that the gold is melted in contact with fire clay rather than investment compound and is held securely within the bowl of the crucible until the metal is thrown, when it passes freely through the large port hole into and through the reservoir chamber into the mold. Vertical centrifugal force plus gravity delivers a

quick, accumulating, sustained pressure that insures remarkably uniform castings.

SUMMARY

Permit me to summarize my paper with just this one sentence: Use the sectional rather than the one-piece impression, the one-piece rather than the sectional casting.

DISCUSSION

Stanley D. Tylman, Chicago, Ill.: In a consideration of the removable partial restoration we realize immediately that we are not dealing with a mechanical proposition alone but also with one that is closely allied with certain anatomical, physiological and hygienic requirements of form, function and health. Unless the two aspects are properly appraised and correlated, any effort in the field of removable restorations will fall short of the mark. A great amount of study and effort has been expended on the mechanical problems of design and retention, also on the materials employed in their construction, but it is only recently that this type of restoration has been considered in its relationship to the biological reactions of the tissues of the mouth and body. A great deal of empiric, philosophical and metaphysical arguments have been presented against this type of restoration but these have lacked the verification of histological findings of the tissues involved. Radiographic evidence alone is subject to personal interpretation. Until the time arrives that we are absolutely sure that the evils of partial dentures outweigh the benefits to humanity it is well to temper our zeal and not be iconoclasts. The partial denture may have its proper place in dentistry. Removable partial dentures are properly divided into three general classes; those that are supported by teeth, those supported by the soft, underlying tissues of the mouth and those partially supported by the soft tissues and by teeth. The last type is the one most likely to meet the requirements of the ideal partial, namely, it must restore functions and form; it must preserve the integrity of the remaining natural teeth by minimizing all strains; it must be hygienic and it must permit of functional activity to the teeth and tissues in so far as the conditions permit. Of the clasp retention types we find that Dr. Roach's recent development promises to eliminate many of the evils attendant upon cast clasp dentures. It recognizes the advantages of simplicity, durability, service and hygiene. If properly designed and constructed, where indicated, it will render safe service. I need not go into the technic of construction except to emphasize the importance of a correct impression. Without that any type of restoration will fail. If properly constructed and maintained, Dr. Roach's bar clasp type of restoration will give a longer and more efficient and safe service, with less deleterious effects on the remaining natural teeth and tissues, than other types of clasp partial dentures.

ORAL FUNCTION AND CHILDREN'S DENTISTRY*

By FRANK A. DELABARRE, A. B., M. D., D. D. S., Boston, Mass.

CHILDREN'S dentistry offers our profession the most effective means of realizing the dream of the control or prevention of dental caries and other oral disorders. Operative repair and hygienic measures hitherto have failed to do more than delay the almost inevitable necessity, for the individual patient, of some artificial substitutes. The adult with a full complement of healthy teeth is really a museum specimen today.

This new attitude toward the dental problem is exemplified in the resolutions sponsored by the Dental Hygiene Council of Massachusetts and unanimously adopted and endorsed by official vote in many local, state and national conventions.[1]

The emphasis of this paper is laid on the fact that employment in full detail of these procedures as developed up to date is only one short step in advance of the old curative and repair measures employed by the profession. It attacks only the field of most frequent occurrence, without seeking to eliminate the cause.

The medical profession is asking for oral health as a necessary integral part of general health. We must cooperate and give a real health service in which the preventive effort overshadows the curative. To be concerned with the health of the teeth alone is not enough; even the prevention of the single item of caries is a short sighted policy.

All hygienic and operative measures must be undertaken for the purpose of influencing general health by attention to local conditions through the maintenance or reestablishment of oral function. From this point of view, it is essential that a case history be taken for the purpose of estimating the general physical status of the patient, the dentist consulting with the pediatrician in all cases where major functional disorders seem to be present.

It is only in recent years that our profession has paid sufficient attention to function as a unit, beginning perhaps with Bonwill, who was the first to consider occlusion as related to function, with the attempt to find normal occlusion. He was the pioneer in professional thought along these lines, and his conception of the problem was the dawning of a constantly broadening point of view, greatly enlarged by Dr. Angle and since then carried on in an intensive way by the development of orthodontia by its many exponents.

Life expresses itself through function. "Function is that mode of action which is proper to any organ." The basis of estimate of function is its efficiency. Oral function is a complex of several

*Read before the Section on Mouth Hygiene and Preventive Dentistry at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 22, 1928.

1. Delabarre, F. A.: Dental Health. (Resolutions adopted by the Massachusetts Dental Hygiene Council, March 29, 1926), J. A. D. A., 13: 1037-1039 (July) 1926. Hyatt, T. P.: Prophylactic Odontotomy, J. Dent. Res., 6, No. 4, 1924-1926.

functions, of which mastication is the chief. But the same set of muscles and parts also function in speech, facial expression and breathing, and the relationship is so intimate that all must be considered together in diagnosis and treatment. The child must be considered as a unit of correlated functions.

Disturbances of major bodily functions are reflected everywhere, while those of minor functions are reflected to those of nearest relationship. Mastication is the first step in the major function of digestion. Its efficiency is dependent on a full complement of healthy teeth, properly arranged and related to each other and the skull, activated by an adequate development, and functioning of all the muscles involved. Muscular coordination, with the resultant balance of muscular forces, is essential to development and efficiency.

Since malocclusion is, in a sense, both a cause and an effect of oral functional disturbance, consideration of its etiology will indicate the appropriate treatment. The causes of malocclusion may be divided for the sake of developing the subject of this paper into (a) basic, and (b) contributory or complicating causes.

Among the basic causes may be listed heredity and organic or functional disturbances which produce arrested or perverted development of the body as a whole, such as malnutrition, faulty heart or lung action or disturbances of the ductless glands. Such cases should have the attention of the physician as well.

I wish to direct attention particularly to the contributory causes, since our advantage in seeing the child early in life and systematically through the years of development places us in a position of distinct advantage in recognizing and eliminating such causes at their inception. This will be of inestimable advantage to the patient and welcomed by the orthodontist, whose cooperation is indispensable.[2]

First and foremost of all is the physical condition of the deciduous or permanent teeth early in life. Neglect of the deciduous teeth or their early loss will in itself almost inevitably lead to malocclusion even when there is no other known cause working. Malocclusion that results from this condition is pronounced in form and complicated to a high degree, and calls for the utmost technical skill for its reduction.

In the same category should be included teeth that are congenitally missing and supernumerary teeth, which act to produce malocclusion in similar but opposite ways.

Next in order is a series of faulty habits, whose influence on occlusion is bad, and the early detection and correction of which is essential. First of these in importance is mouth breathing. This is usually associated with adenoids or nasal obstructions. It is one of the most pernicious and common etiologic factors of malocclusion, and its evil results are seen in the lack of development of some of the local muscles, the lungs, the nose and the air passages, and a consequent arrest of general physical development. When these conditions are present, there is also a greatly increased susceptibility to the infectious diseases of childhood which commonly find their entrance through the nose or mouth.

Faulty muscular function includes the sucking habits of the thumb, finger, tongue, lips and cheeks, which cause a distortion of stresses of the local muscles, disturbing the balance of forces.

Postural habits include sitting posture, supporting the head or face on the hand

2. Resolutions adopted by the American Society of Orthodontists, J. A. D. A., 14: 1328 (July) 1927.

while reading, fatigue posture in standing, which throws out of proper balance the axes of the body in relation to the head and produces undue muscular stress in those muscles that connect the head with the trunk, and faulty sleeping habits such as pillowing the head on the hands or arm.

Faulty habits of mastication are sometimes induced by soreness of the teeth or by imitation of the parents, or by the character of the food provided. Digital examination of the muscles of mastication may reveal lack of muscular tonicity, which may be bilateral or unilateral.

Faulty habits of speech involve improper use of the muscles of the tongue, lips, etc., resulting in a disturbance of the balance of forces through improper use.

In all of the foregoing, we have illustrations of inhibited or perverted muscular action essential to the symmetrical growth of the parts involved. Attention to these details may even avert a threatened malocclusion and will always reduce the severity of complications. All of this observation and treatment is most effective in the first years of life.

Think of malocclusion itself, first, as a result of earlier existing causes and try to eliminate them. If the case has progressed to the point where malocclusion is already evident—and it does appear very early at times—the same procedure is indicated.

Malocclusion is also a cause of lowered efficiency in function. Its diagnosis should and can be made early in life.[3] In this connection, attention must be called to the modifications of normal functional activities that are seen in the developmental stages through which the child passes to reach maturity, the differences being occasioned by the differences in size, form and relationships of the teeth, bones and muscles, not only of the head and face, but also of the neighboring structures.

These changes occur at different ages in different localities, and with varying speed. For instance, prior to the age of 6, there occurs an acceleration of the lateral growth of the jaws, to provide room for the larger permanent incisors and also in the forward direction to accommodate the large first molars. Subsequent to this period, there is a retardation of lateral growth. The coming of the permanent incisors and first permanent molars does not disturb the functional efficiency of the remaining temporary teeth, because the position that they assume is merely a temporary one in harmony with the requirements of the age development.

It is not until between the ages of 10 and 12 that there is a very marked acceleration of the vertical growth of all the parts involved, at the time when the remaining deciduous teeth are lost and are being replaced by their permanent successors and also the second permanent molars. It is at this period that there occurs the greatest change in functional relationships of the parts, when the child develops the adult relationships of teeth and jaws to the skull and becomes in truth an adult with adult function. Appreciation of these developmental changes is essential in the study of mastication.[4]

3. Delabarre, F. A.: Diagnosis of Malocclusion in Its Early Stages, Dent. Cosmos, 60: 789-792 (Sept.) 1918. Matthews, G. F.: Complete Deciduous Dentition at the Eruption of the First Permanent Molars; Its Importance in Diagnosis and Classification, Proc. First Internat. Dent. Cong., 1926, pp. 122-137. Young, J. L.: Restoration of the Normal Occluding Surfaces of the Teeth, Dominion Dent. J., 23: 544-553, 1911.

4. Delabarre, F. A.: Physical Development of the Occlusal Curve, J. Allied Dent. Soc., 9: 546-553, 1914.

The success of children's dentistry will be measured by the oral health exhibited by the child at the age of the eruption of the second permanent molars, with well established normal functional habits, a previous history of freedom from caries, toothache, abscesses and all their disastrous sequelae, and the smallest possible number of fillings (correction) of initial developmental defects.

The orthodontist asks cooperation and promises his in giving service to childhood. This conception of the problem and a conscientious endeavor to develop the detail of approach and technical measures required holds great promise that dentistry will begin now to measure up to its responsibilities and earn for itself its destined place in the battle for health.

Resolutions adopted by the American Society of Orthodontists in annual session, May 2-5, 1927, Chicago, Ill., are as follows:

PRINCIPLES RELATING TO DENTAL HEALTH

The American Society of Orthodontists subscribes to the following affirmations of items and principles relating to dental health.

WHEREAS, the correction of malocclusion is primarily a health measure; and

WHEREAS, the only solution of dental health, both locally and in its relation to general health, lies in the prevention of oral disease; and

WHEREAS, dental prevention is effective in inverse ratio to the age of the patient, children's dentistry is the logical field of preventive measures; and

WHEREAS, the orthodontist needs the complete cooperation of the dentist to insure and maintain dental health before and during orthodontic procedure; and

WHEREAS, the principles of prevention, listed herewith, have been endorsed by fifteen state dental conventions, three national dental associations, and the Fédération Dentaire Internationale; namely, proper attention should be given initial defects; particular care and attention should be given all pits, fissures and grooves before caries appears; no cavity is too small to fill, and the deciduous teeth should have the same care and attention as the permanent ones, as their maintenance in health is essential to the proper development of adult occlusion; and

WHEREAS, disregard of these principles and practices of accepted dental teachings constitutes a transgression of professional obligation to the patient and a serious handicap to orthodontic procedure; therefore, be it

Resolved, that this declaration of policy is the unanimous expression of the belief of this organization, whose members are called upon to uphold it in all their relations with the dental profession and the public; and be it further

Resolved, that these resolutions should be displayed in each orthodontic office and a copy sent to the dentist responsible for the care of the patient immediately on the acceptance of a case; and be it further

Resolved, that this action be given publicity in professional journals and copies sent to the secretaries of various state, national and international dental organizations and to dental school associations.

The resolutions adopted by the Massachusetts Dental Hygiene Council are as follows:

RESOLUTIONS ADOPTED BY THE MASSACHUSETTS DENTAL HYGIENE COUNCIL

WHEREAS, up to the present the attention of dentistry has been centered mainly on the work of restoring lost dental tissue, and

WHEREAS, the only hope of real progress lies in the prevention or early control of dental diseases, and

WHEREAS, prevention, to be effective, must be applied early in the life of the individual —and early in the life of the tooth; be it

Resolved, that dental service must begin early and be systematic and periodic in order to obtain the maximum of prevention with the minimum of operative work, and to properly educate the child in habits of oral hygiene; and be it

Resolved, that in the aim to attain prevention of systemic and dental disease—(a) No

defect is too slight to receive definite attention. (b) The temporary teeth should receive as much care as the permanent ones in order to promote the proper development of the jaws and head, and to maintain function. (c) Particular care and attention should be given to developmental pits and fissures, whether occurring in primary or secondary teeth, or whether decay is or is not present; and be it

Resolved, that the Dental Hygiene Council of Massachusetts declares for the principles and practice of children's dentistry, and maintains that the most effective dentistry that can be done for any individual is the service rendered between the second and fourteenth years of age; and be it

Resolved, that this council calls upon all dentists to uphold these fundamental principles, and to do everything possible to promote the practice of children's dentistry by professional and public education, and in public and private practice.

March 29, 1926.

520 Beacon Street.

DISCUSSION

W. C. McBride, Detroit, Mich.: I would like a further explanation as to the matter of vertical development between the ninth and the fourteenth year.

Dr. Delabarre: Vertical development is most active between 9 and 14. With the absorption of the temporary molar roots and the oncoming of the succeeding bicuspids there occurs a rapid and pronounced elongation of those loose temporary molars which results in opening of the bite; and if we are so fortunate as to see the child that day or that week and study the closed relation of the teeth, we will see that the first permanent molars, which hitherto have been in contact, are thrown apart and are not occluding. That is a most important functional step in development of the vertical relationship. Since the first molars are out of occlusion, they have an opportunity to elongate as they are due to elongate. This step is repeated in succession with the loss of each temporary molar and spread over a period of months or years while the bicuspids are erupting into place. We see this occur each time a temporary molar is about to be lost. It is nature's provision for the development of vertical relationships and the change in functional relationships of the teeth, from the plane of occlusion which persists up to this time all through infancy and childhood to the development of the curve of Spee, which hitherto has not been present.

S. D. Harris, Detroit, Mich.: When the first permanent molars erupt there is not a true occlusion between the upper and the lower molars; that is, there is a cusp relationship, but there isn't a cusp groove relationship as I understand it. Now we often get cases of children at about the age of 6 when the permanent molars are first coming in. We find sometimes that they are not entirely erupted yet and the second deciduous molars necessitate extraction, possibly treatment, but oftentimes we do not find treatment advisable. Now under those circumstances, if we could save the second deciduous molars for two or three months until the first permanent molars erupt and assume a certain occlusal relationship, would we be doing the patient any great service?

Dr. Delabarre: Dr. Harris' question is to be answered on the score of the health of the child. If there is an abscess present and the abscess cannot be cured or controlled, the tooth unquestionably should be extracted, and the orthodontist stands ready to meet whatever results from that too early extraction of the deciduous molar. If the tooth can be saved with no detriment to the health of the child, save it. If the child's health is threatened, the tooth should be extracted.

Dr. McBride: In an orthodontic practice, we have quite a little discussion with the men with whom we work regarding abscessed teeth, and I want your opinion only on what you think of maintaining these abscessed teeth. I have found in my juvenile practice that I can keep most of these abscessed teeth until the time of normal exfoliation. I have found that, during the period of low resistance, as in the springtime when the children have measles and smallpox and all the childhood diseases, there will be a few recurrent conditions. I have to go to the home because the child is confined in bed and I find that teeth that have been treated three and four years previously develop an infectious condition under this lowered resistance.

Dr. Delabarre (closing): I can give only my personal reaction to the question of abscessed teeth. I decide almost every question of that nature that comes up and advise ex-

traction because I feel that the presence of an abscess in the mouth is a serious menace to the child's health. There is another reason for extracting a temporary tooth whose vitality is lost, and that is, the absorption of a pulpless tooth's roots does not proceed according to normal physiologic processes and its presence is a detriment to the development and eruption of its successor. The orthodontist is prepared to maintain the spaces that are lost by extraction of deciduous teeth, and that is a minor evil as compared to an abscess. I did not attempt in my paper to go into the question of treatment but simply to point out the enormous significance of function as related to oral health.

ORAL PATHOLOGY FROM THE STANDPOINT OF THE ORDINARY PRACTITIONER*

By A. HUGH HIPPLE, D.D.S., F.A.C.D., Omaha, Nebr.

PATHOLOGY deals with diseased conditions, and diseased conditions in the mouth are the province of the dentist. He has no monopoly on them, and there are certain morbid conditions found in the mouth which he should not attempt to treat; but he is regarded as a specialist in the treatment of the teeth and their investing tissues. The extraction of teeth, the replacement of lost dental tissue by fillings, inlays and crowns, and the substitution of bridges and artificial dentures for lost dental organs, represent nearly all the activities of the ordinary practitioner. If he is a skilled technician, he is able to do all these things well and he satisfies his patients.

But, unfortunately, there is much disease in the mouth of which the average patient knows little or nothing, and which the ordinary dentist is liable to overlook or ignore. It is also liable to be overlooked or ignored by the ordinary physician, if the patient has occasion to seek his services; for the ordinary physician is just about as familiar with oral pathology as the ordinary dentist is with blood chemistry. The purpose of this paper is to call attention to some of these pathologic conditions which the ordinary dentist can detect by the use of ordinary methods.

Since the mouth is universally recognized as the special field of the dentist, he should consider himself responsible for the detection of every morbid condition that may exist there. A general examination of the mouth should be just as much a routine affair in the case of a patient who presents himself for the treatment of diseased teeth as is the general examination of the body by a physician when a patient complains that his heart is acting badly. But such an examination is the exception rather than the rule.

In the ordinary routine of office practice, the patient comes in to have his teeth examined. With mouth mirror and explorer, the dentist goes over the teeth and decides that they need cleaning and that a certain number of fillings or inlays are called for. The necessary

*Read before the Section on Operative Dentistry, Materia Medica and Therapeutics at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 23, 1928.

appointments are made and the work is done. Five minutes after the patient has left the chair at the end of the final sitting, how many dentists would be able to state whether all the teeth were firm in their sockets, whether there was any traumatic occlusion, whether any of the teeth had sharp or jagged edges, whether the mucous lining of the mouth was normal everywhere, whether the saliva was abnormal in any respect, whether there were any unusual prominences or depressions over the roots of the teeth and whether the tongue presented a healthy appearance? Many, I am afraid, would be unable to answer some of these questions, and yet a few minutes of careful observation would place a dentist in possession of information that might be of very great value.

All one needs to do to determine the general condition of the tongue, gums and mucous membrane is to look at them. Loose teeth are not hard to find; traumatic occlusion tells its story plainly if one is looking for it; rough edges of teeth may easily be seen or felt, and passing the finger over the gums overlying the roots of the teeth will reveal certain bone abnormalities which might otherwise be overlooked.

Following the general survey of mouth conditions, which should always be made, there should be a detailed examination of the teeth themselves and the adjoining tissues. Cavities that need to be filled, useless teeth and roots that require extraction, and spaces that call for bridges or dentures will be found as a matter of course. I need not dwell on them. It may also be assumed, I hope, that all pulpless teeth will receive at least a careful examination. To determine their condition, the roentgen ray is a necessity, and transillumination is very helpful. Transillumination does not take the place of the roentgen ray, as it does not show disease of bone. It does disclose infection of the pericemental membranes in some cases that are negative roentgenographically. I shall not attempt to add to the voluminous literature on the subject of the pulpless tooth or that of root canal filling. Anything I might say on these subjects would be merely the expression of my own opinions, which may or may not be correct.

One of the most common pathologic conditions in the mouth, and one which seldom receives the attention it merits, is gingivitis. It is found in practically all mouths that require the services of a dentist, and, if overlooked or neglected, produces dire results. Knowing that much of the gingival inflammation we see is due to deposits on the teeth, and knowing also that a thorough prophylactic treatment will result in much improvement, we too frequently give the treatment, if necessary, instruct the patient in the proper use of a toothbrush, tell him to report at certain intervals and let it go at that. As a matter of fact, according to Dr. Black, less than half of the areas of gingivitis are caused by deposits of calculus. Many of them are the result of ill-fitting crowns and bridges. Many more are due to bad margins of fillings. Improper contacts of fillings and crowns are responsible for a large number of cases. Some are caused by traumatic occlusion, and others are the result of abnormal arrangement of the teeth. Frequently, the patient is entirely unaware that there is anything wrong with his gums, and refuses to attach any serious significance to the little red areas when they are pointed out to him.

The dentist should not only search for these inflammatory conditions but should also endeavor to cure them. Removal of

the cause is all that is usually necessary. The trimming of an overhanging filling, the polishing of a rough surface, the removal by grinding of a too prominent cusp and the closing of a contact by a properly contoured filling will work wonders in many of these cases. When the treatment calls for the removal of a crown or bridge, the patient may hesitate to give his consent, and, of course, the work cannot be done without his consent. We know, however, that neglected gingivitis is likely to result in inflammation of the pericemental membrane, the formation of pus pockets and the eventual loss of the teeth involved. When the patient is told that these little areas of inflammation indicate the first stage in the development of pyorrhea, he is usually willing to have anything done that may be necessary.

Another inflammatory condition, analogous to gingivitis, is Vincent's infection, commonly known as trench mouth. This was a rare disease not so many years ago, but, unfortunately, it is common today. In an examination of 1,100 individuals who presented themselves for operative work at Tuft's Dental School in 1927, Dr. Daley found that 359 had well-developed Vincent's infection. The diagnosis, based primarily upon the clinical symptoms, was confirmed by microscopic examination of smears. The startling conclusion was reached that, in Boston, one individual in every three has Vincent's infection.

If we are to accept these findings, and there seems to be no good reason for doubting them, we must conclude either that Vincent's disease is much more prevalent in Boston than in other parts of the country, or that it exists in many mouths, unsuspected and untreated. The fact that the 1,100 patients did not present themselves for treatment of gingival disturbances lends color to the second conclusion. Perhaps the explanation is to be found in the fact that the effects of the disease, while similar in all cases, vary greatly in their intensity. During an acute attack, they are likely to be severe, but if the inflammation is of a subacute character, the symptoms are less pronounced, and, in the chronic form, the disease may be only mildly troublesome. When a patient presents himself for treatment of Vincent's infection, he is usually suffering from an acute attack. The gingivae are inflamed and covered here and there with a whitish membrane which is easily removed. The gums bleed freely. There is a history of a sudden onset causing much pain and making mastication difficult or impossible. The breath has a characteristic odor, and there is usually a pronounced systemic disturbance. Bacteriologic examination will reveal large numbers of Vincent's spirilla and fusiform bacilli. These organisms, we are told, may be found in many normal mouths, but not in such large numbers.

In the treatment of this condition, practically all the antiseptics with which we are familiar have been used with success, and each practitioner seems to have his own favorite remedy. While any good germicide will give results, it would seem that such as are most efficient in the destruction of spirochetes are indicated. Ten per cent arsphenamin in glycerin is highly recommended, and, in my hands, an oily liquid containing 2 per cent sorisin, has given excellent results. After the acute attack has subsided, the disease is likely to persist in a chronic form. The gums may remain sensitive, and, from time to time, the patient may have an actual flare-up of the disease, but the recurrence will be much less severe than the original attack.

Bleeding from the gums seems to be the most characteristic symptom. Any unusual tendency to bleeding from the gingivae should be regarded as presumptive evidence of a possible Vincent's infection, and should be treated accordingly. Incidentally, I may say that careful attention to the removal of the ordinary causes of gingivitis already referred to will make a recurrence of Vincent's infection much less likely.

Cancer is being made the subject of research and is being vigorously fought throughout the entire civilized world. Any part of the oral cavity may be the site of a cancerous lesion, but the lower lip and the tongue seem to be the most frequent locations. While the etiology of the disease remains obscure, in spite of all the study that has been devoted to it, all authorities seem to agree that long continued irritation of the mucous membrane, resulting in an abrasion, is a strong contributing factor. Chemical irritation also seems to play a part, and the predisposition of smokers to cancer may be partly the result of the mechanical irritation of a pipe or cigar and partly the result of tobacco poisoning.

The ordinary dentist is not qualified to treat cancer, nor should he be expected to make a positive diagnosis of it. He should be eternally on the lookout for the disease, Any sore on the lips, tongue, cheeks or gums which refuses to heal promptly when the cause has been removed, and any sore which persists without any apparent cause, should be referred to a competent surgeon for diagnosis. Tumors in the mouth should be carefully scrutinized. Most of those seen by the ordinary practitioner are benign. Connective tissue growths appear rather frequently in the oral cavity as the result of chronic irritation. The pressure from a plate sometimes causes a swelling of considerable size.

Occasionally, we see a small hard tumor on the surface of the gum, in an interproximal space, which has forced the teeth apart and loosened them. These tumors develop slowly and may exist for years without much increase in size. On the median line of the hard palate, on the alveolar process and in other locations are frequently found bony excrescences, varying in size from that of a small pea to that of a split walnut; or becoming even larger. They are of slow growth, and give no trouble; and, if they are small, the patient is frequently unaware of their presence. These tumors do not destroy tissue and are not at all dangerous. While these and some other varieties of mouth tumors are benign, the possibility of any new growth being sarcomatous should never be overlooked.

The diagnosis between a malignant and a nonmalignant growth is by no means easy, particularly in the early stages of development; and yet if it is malignant, the prognosis is never favorable unless an early diagnosis is made and the growth promptly excised. In many cases, such a diagnosis can be made only by microscopic examination. The ordinary practitioner should not rely on his own judgment. The patient should be advised of the possible seriousness of the condition and be urged to seek expert advice. When it is remembered that, in a few weeks, a case may pass from a local lesion, excision of which will effect a cure, to a lymphatic involvement, which makes the chances of cure remote, it will be seen that prompt action is imperative. It should be noted in this connection that pain is not an important factor in these cases. In the early stages, it is very slight.

While detection of a malignant growth is of the utmost importance, its prevention is equally important. If all useless teeth and roots in the mouths of our patients were extracted; if the sharp, jagged edges of teeth were ground off and made smooth; if no ill-fitting dentures were allowed to be worn; if no fillings, bridges or crowns were permitted to impinge upon the soft tissues; if, in short, all sources of mechanical irritation were removed, cancer of the mouth, we are told by those best qualified to speak, would be much less common than it is.

The ordinary practitioner who has been out of college for a few years has forgotten many of the things that he learned while there, but he has a working knowledge of the sciences which enables him to carry on. He probably could not pass such a good examination in physics as he did when he graduated, but he can make a better casting. He may have forgotten some of the details of dental histology, but he can prepare a better cavity. The names of some of the commoner forms of bacteria found in the mouth may have passed from his mind, but he is better qualified to deal with a pathologic condition produced by those bacteria. Of course, the more information he acquires and the more he retains, the better he is fitted to practice dentistry. Every dentist owes it to himself and to his patients to increase his knowledge and improve his technic as much as possible, and if he does this and gives to each of his patients the full benefit of what he knows, and what he can do, he will be able to render efficient service to humanity in the treatment of oral disease.

DISCUSSION

Frederic R. Henshaw, Indianapolis Ind.: In these modern days there is such an extreme tendency toward specialization that the "ordinary dentist" is quite liable to be lost sight of. By "ordinary dentist or dental practitioner," I take it that Doctor Hipple means the man who takes care of the great majority of the public, holding himself in readiness to meet all of the many dental emergencies that may present themselves in his community, giving the best in service that lies within his ability. His number is "legion" and he represents a cross-section of all that is best in our profession. His traditions have been handed down to him from the greatest leaders that this profession has known. This "ordinary practitioner" has his limitations, recognizes them, and, for the most part, is eager to avail himself of all such timely suggestions and advice as is offered by Doctor Hipple. Too much stress cannot be placed on the necessity of thorough and careful examination of the entire oral cavity, since it is too true, as Doctor Hipple has said, that not enough care and attention is given to this important procedure, using all available means such as transillumination, the roentgen ray, fine explorers, etc., in the examination of the teeth as well as the investing tissues. One factor of dental practice that has suffered serious neglect at the hands of the dentist is that of "cleaning teeth." It may be more conventional to speak of this operation as "prophylaxis," but I prefer to call it by its true name and to call attention to the fact that, in too many dental offices, this operation is done very badly or not at all. Cleaning teeth cannot be the province of the specialist since every patient in the land needs and deserves this kind of care, and it therefore becomes the duty and obligation of every dentist, ordinary practitioner and specialist, to see that the patients who entrust themselves to his care shall receive the very best service in this particular. Every mouth in which the teeth need cleaning at all, and that would include practically every person, is in some stage of pathologic disorder. Whether the dentist deems it beneath his dignity to clean teeth; whether he has never mastered the technic or whether he is simply lazy, careless or indifferent would be determined by observation of the individual dentist, but the fact remains that this important procedure is sadly neglected in far too many dental practices. It should be the recognized duty of every dentist to see that all mouths coming under his care are made

clean and kept clean. I heartily indorse Dr. Hipple's injunction in regard to malignancies. Neither the ordinary dentist nor the ordinary physician is capable of making proper diagnosis of some of these conditions, and it is therefore incumbent on both to call on the services of the trained pathologist, who is always available in the larger centers. Bacteriologic laboratories can be utilized by the dentist as well as the physician, and in most states, such service is provided without cost. In the modern dental school, the student is given a practical course in the principles of medicine and physical diagnosis which equips him to deal with pathologic conditions on an equality with his medical confrères. Those who have been graduated in an earlier generation will be enabled by study of modern texts to recognize the general appearances of abnormalities that call for consultation. Modern physiology, with the wonderful developments of recent times, draws our attention to perhaps the greatest factor of all, nutrition. Any fault, aberration or failure in bodily metabolism must be considered pathologic, and proper nutrition plays a very great part in establishing and maintaining a proper balance. There are those who implicitly believe that many of our most pernicious pathologic disturbances, including dental caries, may be bettered and even controlled by the simple expedient of proper feeding. Whether this can be fully demonstrated remains to be seen, but, at all events, a thorough study of the current literature on this interesting subject is earnestly recommended. On the "ordinary dentist" depends the dental welfare of the great mass of our people, and the dental welfare is so intimately associated with the general physical welfare that there can be no line of separation. Therefore, it is timely to have presented such papers as that of Doctor Hipple.

R. W. Bunting, Ann Arbor, Mich.: Truth often hurts, and it is a brave man who dares to tell us unpleasant facts. Dr. Hipple has made a statement that is a sad commentary on dental practice, and unfortunately it is true. He says, "The extraction of teeth, the replacement of lost dental tissue by fillings, inlays and crowns, and the substitution of bridges and artificial dentures for lost dental organs, represent nearly all the activities of the ordinary practitioner." Why did he omit the treatment and prevention of disease, the care of investing tissues about the teeth, the diagnosis of local and systemic diseases? Why did he confine his list of activities of the average dentist wholly to mechanical procedures? Because they are practically the sole function of thousands of our profession today. Dr. Hipple points out many phases of diagnosis and treatment which lie within the domain of the dentist and which should not be overlooked. In other words, he calls our attention to the biologic aspects of our profession which should have equal consideration with and often priority over the restorative procedures. The prime consideration in every dental operation should be the greatest good to the patient. Often, the saving of a tooth by a filling or a crown is the greatest injury we could do to our patient and for many the kindest service would be to make the mouth edentulous. An intelligent diagnosis, including all the special features enumerated by the essayist, Dr. Hipple, should always precede and determine the course of action. May I call your special attention to the need for more accurate diagnosis of peridental conditions? Those of us who are giving special attention to the treatment of peridental diseases see so many cases which have been neglected by the family dentist until their treatment and cure are almost hopeless. Too often does the patient ask, "Why didn't my dentist tell me about this before? You say that I have had this condition for years, but he has never mentioned the fact." Such a situation is embarrassing and unfortunate; for if peridental disturbances are recognized in their incipiency, they may easily be arrested by very simple prophylactic measures. Pyorrhea is a preventable disease, and its appearance in an advanced stage in patients who have been under regular supervision should be an occasion for extreme chagrin on the part of the attendant dentist. Dr. Hipple speaks of the great prevalence of Vincent's infection. It is true that a large percentage of our population carry the Vincent's organism, which either lies dormant or causes a chronic low-grade infection. The treatment of the chronic types may often be much more difficult than the acute cases, for, in the former, the organism appears to be intrenched in the tissues and offers considerable difficulty in attempts at eradication. Many drugs have been used for the treatment of these conditions, but in our experience the daily topical and subgingival

application of 1 per cent acriflavin for several consecutive days has given the most beneficial results. Solutions of equal parts acriflavin and gentian violet have also been employed. The most active cases will subside in three or four days under such treatment. The most important thing is to follow any therapeutic treatment by thorough prophylactic treatments as soon as the infection subsides, and to keep the teeth clean until the proximal tissues have been restored and the gingivae return to normal. Otherwise, infection remains and becomes chronic, a form which it is often difficult to treat successfully. As to the responsibility of the dentist in the recognition of neoplasms of the mouth, we would emphasize the statement of Dr. Hipple that the greatest service that he can perform is the eliminating of all sharp and irritating roots or teeth which may cause chronic injury of the adjacent soft tissues. When there is excessive abrasion of the teeth, the occluding teeth often come together like millstones, the peripheries of which are sharp and pinch the cheek and tongue during mastication. Cancerous growths often arise on the cheek or tongue corresponding in position and shape to the site of such injury. The sharp edges of enamel may be removed and the tooth contours rounded so that the tissues are no longer impinged. In view of our present knowledge of the importance of dental and oral diseases and their relationship to the general health, it is very important that the dentist have the broadest possible concept of his special field. The art and technic of operative dentistry should in no wise be detracted from, but the chief aim is the good of the patient, to which all other considerations must conform.

CALCIUM METABOLISM STUDIES ON THE NATURE AND ROLE OF THE ACTIVATORS: RESEARCHES ON FUNDAMENTALS FOR THE PREVENTION OF DENTAL DISEASE*

By WESTON A. PRICE, D.D.S., M.S., F.A.C.D., Cleveland, Ohio

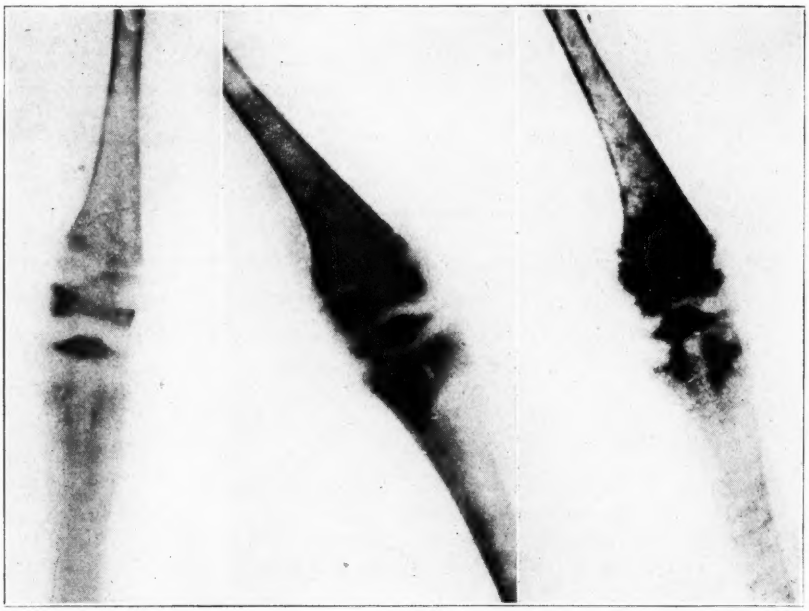
PROBABLY no subject which has engaged the interest of the dental profession of today or of any other period promises so much help to humanity as does the newer knowledge of calcium metabolism. That proper calcium utilization is important because of its effect on resistance and susceptibility to infection as well as for tooth and bone formation will be part of the evidence presented in this paper.

The data available clearly indicate that calcium anabolism and katabolism are dependent in part on chemical substances which must be present in the system and which are derived chiefly from the direct and indirect effects of radiant energy on plant and animal tissue. These substances are usually spoken of as vitamins. They have many characteristics, as they relate to constructive and destructive calcium metabolism, which have led me to think of them and speak of them as activators. I have accordingly spent much effort in recent

*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Sixty-Ninth Annual Session of the American Dental Association, Detroit, Mich., Oct. 27, 1927.

years in the study of the nature of the activators for calcium metabolism.

In a paper read before this Association in November, 1924,[1] I reported that when blood was withdrawn from an animal and the serum exposed to radiant energy from the sun or other source of ultraviolet light, and the serum so treated was injected intravenously into the same animal, there was a marked rise in the calcium, which was evident in two hours. I showed further that while an exposure of fifteen minutes raised the blood calcium, one of sixty minutes depressed it. I further showed that the serum that was capable of doing this was capable of making a photographic impression on a sensitive plate. Those studies also reported that many other substances were found to be affected—olive oil but slightly, cod-liver oil very actively, by this treatment. I also reported treatment of cases with oil specially exposed to radiant energy.



A B C

Fig. 1.—Progressive calcification in knee of a chicken in which leg weakness had been produced by a deficiency diet and lack of sunshine, treated with cod-liver oil topically and internally as indicated. *A*, deficiency diet plus sunshine through Cleveland smoke. *B*, twenty days later, after cod-liver oil had been rubbed on the leg. *C*, six days later, with cod-liver oil added to diet.

1. Price, W. A.: Fundamentals Suggested by Recent Researches for Diagnosis, Prognosis and Treatment of Dental Focal Infections, J. A. D. A., 12:641 (June) 1925.

In a paper read before this Association in Louisville in September, 1925,[2] I presented data on the rôle of parathyroids in calcium metabolism and on the relation of direct sunlight, screened sunlight, cod-liver oil, cod-liver oil activated, cholesterol, raw and activated, parathyroid extract and ultraviolet radiation to the development of several large groups of chicks, including many data on blood calcium studies. A significant new observation was that the rubbing of raw and activated cod liver oil (by "activated" I mean exposed to radiant energy) on the chicks both restored growth and healed rickets-like lesions of the bones. Even more striking in this connection and of great significance was the evidence that, whereas the lymph has ordinarily a calcium level approximately half that of the blood and probably all or nearly all diffusible calcium, the topical application of raw and activated cod-liver oil not only raised the level of the blood calcium but also raised the local level of the lymph calcium to approximately four times that of normal lymph or twice that of blood of the same animal, instead of half. Since radiant energy applied to the cod-liver oil made it possible for oil so treated to have a distinctly greater effect than raw cod-liver oil, it seemed evident that the oil was the carrier of a force produced by the radiant energy.

In a paper read before the National Academy of Sciences in Washington, April, 1926,[3] I presented data showing that there was a progressive increase in the capacity of cod-liver oil to receive and transfer radiant energy with progressive exposure through a limited range, as evidenced both by animal experimentation and by physical and by chemical tests, and, further, that the disturbances expressing themselves in part as dental caries, especially in childhood and pregnancy, were directly related and in a marked degree subject to control or marked improvement by treatment with raw and activated cod-liver oil, with and without calcium lactate, as conditions indicated. A negative calcium balance (by which I mean here serum $Ca \times P = 28$ less than 40) indicating the stress of pregnancy, was shown to be changed from minus 28 to minus 7 in a few weeks.

The importance of preventing avoidable obstructions to radiant energy was supported by data in a paper read before the Second Chemical Equipment and Process Engineering Exposition in Cleveland, May, 1926.[4] Chickens on deficiency diets were not able to get enough energy through the Cleveland smoke to maintain calcium metabolism and went down with leg weakness and serious bone and tissue disturbances. It was found possible to put some of them back on their feet either by rubbing with raw or activated cod-liver oil or by exposure to radiant energy from an artificial source, or by feeding it to them.

2. Price, W. A.: Newer Knowledge of Calcium Metabolism in Health and Disease, with Special Consideration of Calcification and Decalcification Processes, Including Focal Infection Phenomena, J. A. D. A., 13:1865 (Dec.) 1926.

3. Price, W. A.: Calcium Metabolism Studies. (a) Raising of Serum Calcium by Topical Applications of Raw and Activated Cod Liver Oil. (b) Disturbances Associated with the Active Dental Caries of Childhood and Pregnancy, Am. J. Dis. Child., 33:78-95 (Jan.) 1927.

4. Price, W. A.: Relation of Light to Life and Health, Indus. Eng. Chem., 18:679 (July) 1926.

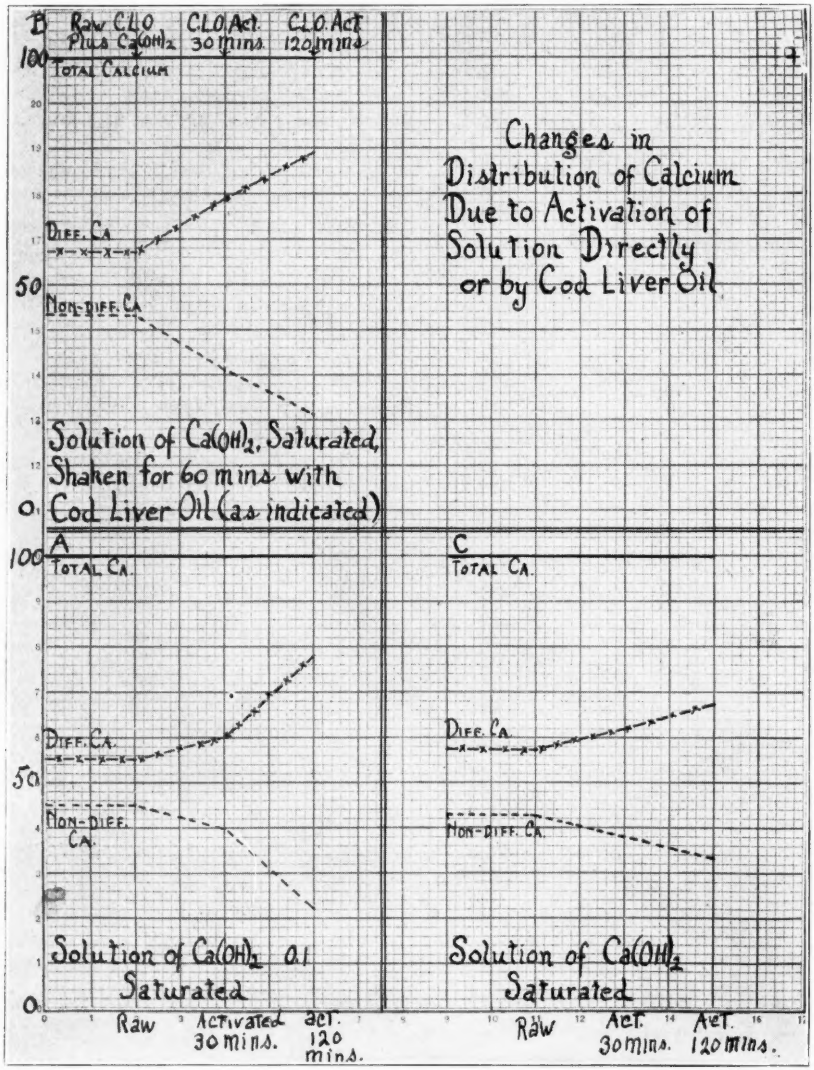


Fig. 2.—Effect of activation on diffusibility of calcium in calcium hydrate.

The changes produced in the knee joint of a chicken treated as indicated when it had gone down are shown in Figure 1. Note the marked effect of topical applications of cod-liver oil as well as from feeding it, and in a relatively short time.

Extensive studies have been made on the distribution of calcium in the blood

and of the nature of the bond between calcium and proteins. These were reported in an extended communication read before the Seventh International Dental Congress at Philadelphia, in August, 1926.[5] Three principal calcium factors were studied, namely, total, diffusible and nondiffusible. The data presented indicated that not only the level of total calcium, but also its distribution as diffusible and nondiffusible could be greatly influenced in a few hours by many procedures, among which were the administration of calcium lactate doses. A great irregularity or inconstancy was found in different samples of cholesterol. In the same paper, I reported studies on milk as a source of activators. A special study that was reported in that communication included the repeated blood and milk chemical analyses of a group of sixteen cows, extending over a period of eight and one-half months. The milk of cows under treatment by different methods produced quite different effects on different groups of chicks maintained on a similar deficient diet. The total milk calcium, which

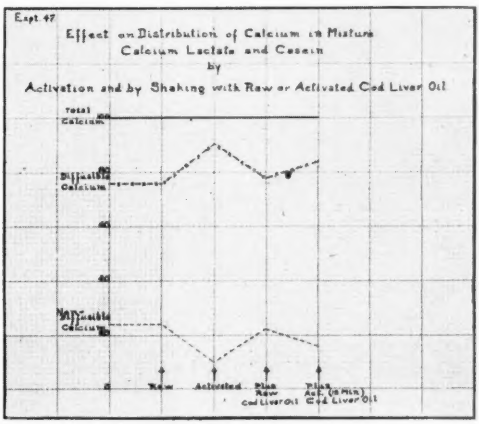


Fig. 3.—Effect of activation on diffusibility of calcium in calcium lactate and casein solution.

alone, cod-liver oil alone, cholesterol alone and combinations of these substances. The remarkable fact that the diffusible and nondiffusible calcium levels could be made to cross each other five times in a few hours was demonstrated. The effect of administering cholesterol that had been activated was shown to be very marked, and therefore made possible treatment with very small normally showed a progressive decline, was in several instances caused to increase, notwithstanding the double load of lactation and gestation.

For several years, I have made blood chemical analyses a part of my diagnostic procedure in the study of the relation of dental infection to systemic disturbance. These analyses now total more than 1,500 and include many phases of calcium and phosphorus in cells, serum and plasma. Much evidence has been accumulating which indicates that such fac-

5. Price, W. A.: Calcium, Its Activation, Utilization and Metabolism, J. A. D. A., 14: 729 (April) 1928.

tors as total calcium may be misleading. The importance of the activators and the need of detailed information regarding them have been emphasized by each new step in these researches, both clinical and biochemical.

An important advance in the study of this problem seems to have been the use of biochemical reactions in test tubes as well as by the much less rapid procedure of animal reactions. Just as the administration of cod-liver oil or cholesterol or its topical application will shift the diffusibility of the calcium of the blood and two hours. Note the progressive increase in diffusible calcium. The first one saturated, *B*, was shaken with cod-liver oil that had been activated thirty minutes and two hours. Note the marked increase in the diffusibility of the calcium as a result of the activation of the cod-liver oil. The second one, series *A*, is one-tenth saturated and otherwise like the upper series. Note the greater influence on the diffusible calcium with this amount of dilution. It is significant that the effect is the same from treating milk as when treating a mixture of cal-

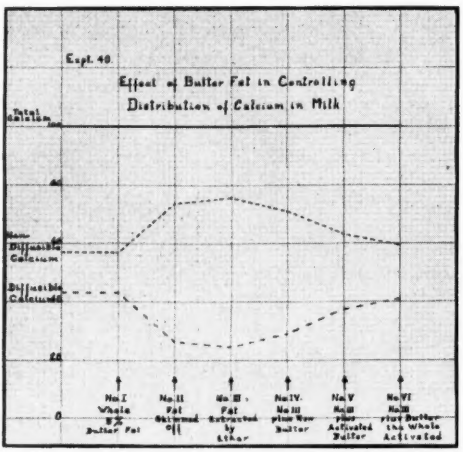


Fig. 4.—Influence of butter fat on the diffusibility of the calcium in milk.

of an animal, it has been shown by these researches that they can produce this same shift when applied to the serum of the animal in a test tube, or similarly to many organic and inorganic solutions.

A typical illustration will be found in Figure 2, which shows the effect on the distribution of calcium in three solutions of calcium hydrate by activation directly and by being shaken with cod-liver oil. The last one, *C*, shows a saturated solution, activated directly for thirty minutes

cium lactate and casein with each direct radiation, raw cod-liver oil and activated cod-liver oil and that raw cod-liver oil acts differently from activated. This effect on calcium lactate and casein is shown in Figure 3. The cod-liver oil does not appreciably combine with the mixture, and no loss can be detected in its weight. In the figures, the dash and cross lines represent diffusible calcium; the series of dashes, nondiffusible calcium, and the solid line, the total cal-

cium. Note that the activation increases the diffusibility, raw cod-liver oil decreases it and activated cod-liver oil sends it up again.

The equilibrium ratio between diffusible and nondiffusible calcium at the beginning is shown at 76 per cent and 24 per cent. Exposing the mixture to ultraviolet radiation increased the diffusible calcium to 90 per cent and reduced the nondiffusible to 10 per cent. Shaking with raw cod-liver oil reduced the diffusible calcium to 78 per cent and increased the nondiffusible to 22 per cent. Shaking with activated cod-liver oil having fifteen minutes' activation increased the diffusible calcium to 84 per cent and reduced the nondiffusible to 16 per cent. Many biologic substances besides milk products and serum have been so studied, and it has been found that, in general, the same effect is produced on the distribution of the calcium, and indeed it now seems abundantly demonstrated that these effects are usually produced in animals and individuals by treatment such as exposure to ultraviolet radiation or the administration of raw or activated cod-liver oil; i. e., raw cod liver oil usually decreases diffusibility, while activated cod-liver oil and irradiation increase it. From my large series of blood chemical studies with regard to calcium levels, I find that normally there seems to be about 5 per cent more diffusible than nondiffusible calcium; that is, with a total serum calcium of 10 mg., a little more than five should be diffusible and a little less than five nondiffusible. A variation of 2 or 3 mg. in either direction seems usually to express itself with distinct physical disturbances. Evidence that I have accumulated in support of this observation will be published elsewhere.

Since one of the principal sources of activators for calcium metabolism is to be found in the dairy products, extended studies have been made of milk and milk products. Some of the activators with which we are chiefly concerned are carried in the butter fat and are well demonstrated by the data given in Figure 4. In the whole milk, the diffusible calcium is at 44 and the nondiffusible calcium at 56. After skimming, the diffusible lowered to 26, with the nondiffusible at 74. When the remaining fat was extracted with ether, the diffusible calcium lowered

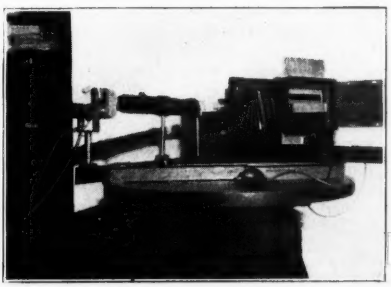


Fig. 5.—Specially constructed spectrograph for studying the influence of different bands of the spectrum in biologic reactions.

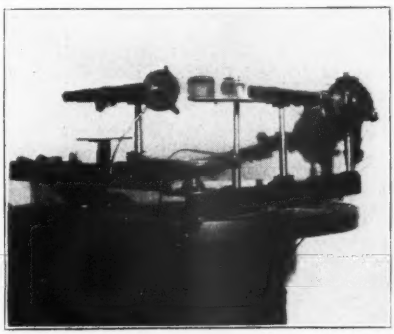


Fig. 6.—Spectroscope with complete optical system of fluorite, using three prisms in train.

a little, to 24. On the addition of raw butter, the diffusible increased to 30. Adding activated butter raised it to 38, and on activating the mixture after adding raw butter, the diffusible calcium increased to 41. While these accessory food factors have been chiefly studied by animal experimentation, evidence has been presented by Carr and Pierce[6] and by Yoder[7] that chemical tests of vitamins A and D have distinct value and eral others, the need for the exposure of the cow giving the milk to a proper amount and form of radiant energy. I have been able to shift my own diffusible calcium and nondiffusible calcium through considerable range, this depending on whether I took raw or activated cod-liver oil, and easily too far.

Little consideration has been given regarding the amount of ultraviolet light from different parts of the spectrum

TABLE 1.—MARKED VARIATIONS IN DIFFUSIBILITY OF CALCIUM OF SERUM OF PATIENTS

Case*	Total Serum Calcium	Cell Calcium	Diffusible Calcium	Non-diffusible Calcium	Inorganic Phosphorus	Calcium Balance	
Group I 1504	9.96	1.68	7.32	2.64	2.99	− 10.20	
1448	11.25	2.43	6.33	4.82	3.72	+ 1.66	
Group II 1425	11.06	2.17	7.61	3.45	2.04	− 17.40	
1409	11.23	....	8.03	3.20	2.73	− 9.40	
1460	12.54	2.96	8.20	4.34	3.72	+ 6.40	
1407	11.34	0.86	8.27	3.07	3.60	+ 0.70	
1399	11.25	2.01	8.66	2.59	2.16	− 15.70	
Group III 1452	10.49	1.36	3.80	6.69	3.89	+ 0.80	
1473	11.16	3.31	3.42	7.74	3.06	− 5.90	
1471	12.41	2.95	4.37	8.04	3.86	+ 7.90	
1470	10.55	3.01	3.83	6.72	3.43	− 3.80	
1404	11.50	1.40	3.41	8.09	1.91	− 18.00	

*The serum Ca × P reading from Group I, 1504, through Group III, 1404, was: 29.80; 41.66; 22.60; 30.60; 46.40; 40.70; 24.30; 40.80; 34.10; 47.90; 36.20, and 22.00, respectively.

are parallel to the much more time-consuming method of animal tests. The researches, previously referred to, on the cows indicate, as do the studies of sev- needed or the influence on the diffusibility of the calcium produced by different bands. There is considerable difference in the diffusibility of the blood calcium of individuals studied for the possible relation of dental infections to their disturbed health, as shown in Table 1. The high diffusible calcium of the two in the first group is probably due in part to their having been treated with ultra-

6. Carr, F. H., and Price, E. A.: Determination of Vitamin A from Color Reactions Attributed to Vitamin A, Biochem. J., 20:497, 1926.

7. Yoder, L.: Relation Between Peroxidation and Antirachitic Vitamin, J. Biol. Chem., 70:297 (Oct.) 1926.

violet rays from a quartz mercury arc lamp. The second group is composed of cases of high diffusible calcium in which such treatment had not been given, and it would clearly be contraindicated with them. The third group of five have low diffusible calcium, and some means is needed for bringing a more nearly normal equilibrium between diffusible and nondiffusible factors. There is need for the elimination of harmful influences, while the helpful forces of the ultraviolet radiation and, as far as I know, no data are available to date showing the specific effect of the different spectral bands with regard to such factors as diffusibility of calcium, vitamins A and D, inorganic phosphorus and others directly related to calcium metabolism.

In order to accomplish this, I have had constructed a spectrograph, especially designed for testing the effects of the different bands in various of the biologic reactions. For this, I have used

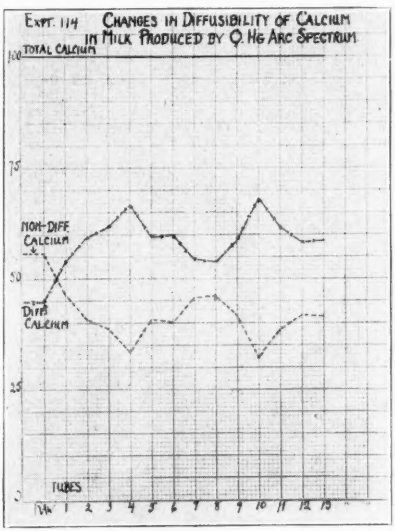


Fig. 7.—Effect of different bands of the spectrum on the diffusibility of calcium in milk. Tubes with lower numbers in infrared, tubes with higher numbers in far ultraviolet.

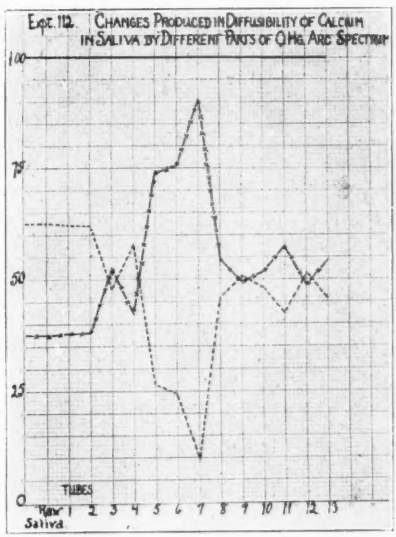

Expt. 112. Changes Produced in Diffusibility of Calcium in Saliva by Different Parts of Q. Hg. Arc Spectrum
100
75
50
25
0
Tubes
Air 1 2 3 4 5 6 7 8 9 10 11 12 13
Saliva

Fig. 8.—Extreme sensitiveness of saliva to change in diffusibility of calcium with different bands of the spectrum.

violet sources of light are retained. To accomplish this, a first requisite is a knowledge of the influence of the different parts of the spectrum in the matter of influencing helpfully calcium metabolism factors. Practically all of the observations that have been reported have included the full range of ultra-

an all fluorite optical system, with three prisms in train. Of course, glass cannot be used because it does not transmit far into the ultraviolet. Quartz can be used, but it has distinct disadvantages as compared with fluorite. This instrument has also been constructed to record on a clock-driven film spectrums from various sources, such as the sky and artifi-

cial sources, and is provided with attachments for exposing various chemicals in quartz containers to various bands of the spectrum. A great number of new data have come out of this research, indicating that there has been much misapprehension regarding the uniformity of the influence of the different parts of the spectrum from any source which extends into the ultraviolet. Figure 5 shows the instrument as arranged for biospectographic work, and Figure 6, as a spectroscope.

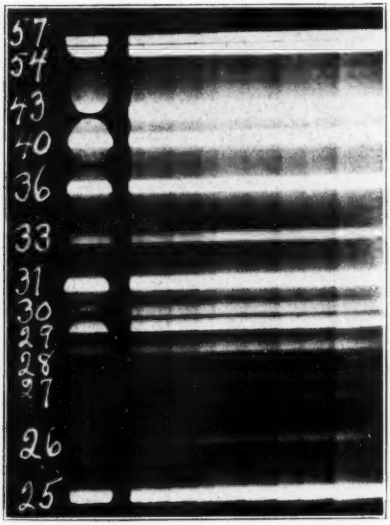


Fig. 9.—The registration of spectral lines in relation to the quartz containers.

An illustration of the striking difference in the photochemical effect of different lines is shown in Figure 7. In this, it will be seen that there is a marked difference in the diffusibility of calcium, depending on the band in the spectrum which is acting on the chemical in question. It is even more strikingly illustrated in Figure 8, which shows the changes produced in the diffusibility of calcium of saliva by exposure to different parts of the mercury arc spectrum. The method of recording the relation of the spectral lines with quartz tubes is shown in Figure 9. It is significant that these chemical actions appear at a considerable distance into the infrared and extend into the ultraviolet beyond the range of sensibility to the panchromatic photographic plate used for this record. These strong lines range from 5,790 to 2,537 angstrom units.

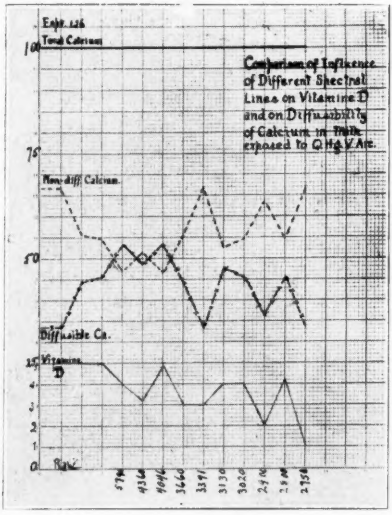


Fig. 10.—Destructive effect of extended exposure to different bands of the spectrum. Destruction of vitamin D follows somewhat the effect on diffusibility of calcium.

A comparison of the influence of different spectral lines on vitamin D and on the diffusibility of calcium in fresh milk, when it is exposed to the quartz mercury-vapor arc, is shown in Figure 10, in which it will be seen not only that there is a great difference, but also that there is, as has been shown in preceding

illustrations, an actual reversal of direction of change. Vitamin D in the milk is apparently destroyed by the short wave lengths in this experiment. Note that the D curve follows in general the diffusibility curve of the calcium. This and many other data in these studies suggest a close relationship that cannot readily be accidental, as though the diffusibility of the calcium may be related to the amount of vitamin D present.

milk and to milk shaken with cod-liver oil which has been activated by the various bands of the spectrum of the same source of radiant energy. While the graphs do not completely resemble each other, the effects produced by particular spectral bands are remarkably similar and both show many reversals.

Since only that radiation which is absorbed can produce chemical change, we have by this law a means for studying

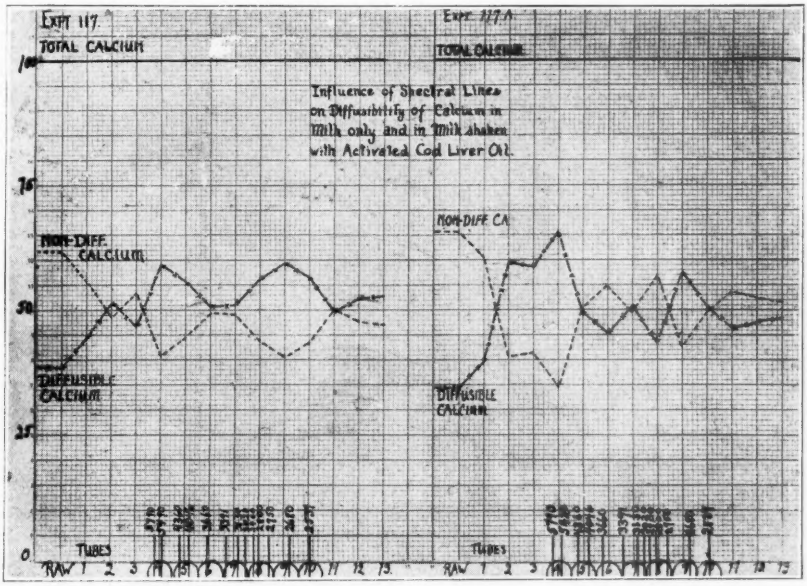


Fig. 11.—Comparison of the effect of various bands of the spectrum whether applied directly to the milk or applied to cod-liver oil, and shaken with milk.

I have previously shown that the diffusibility of calcium in various mediums can be influenced similarly by direct ultraviolet radiation of the mediums and by shaking it with cod-liver oil that had been exposed to ultraviolet radiation. In Figure 11 will be seen the remarkable similarity of the effect of particular bands in the spectrum when applied to various substances with regard to both the nature of the changes and the bands of the spectrum which produce them. Figure 12 shows a comparison of the absorption spectrums of two cod-liver oils and of two butters which show marked differences, particularly of the absorption bands 3660A, 3391, 3020-2900. Normal rabbit's blood absorbs completely

bands 4046 and 3391 and partially bands 4360, 3660 and 3130, and all beyond. After activation by ultraviolet radiation, it absorbs completely 3130 and now a new line appears with band 4046 and less absorption of band 4360. This is a position of marked change in the diffusibility of calcium shown in several preceding figures and will be discussed further later.

While many workers have reported results of experimentations with concentrates made from cod-liver oil and other substances, one of the most important

I have been interested to compare the action of this chemical with the foregoing data. In Figure 13 will be seen the influence of different spectral bands on vitamins A and D in cod-liver oil and ergosterol, separately and together. By following the key, the various graphs can be followed. Judged by the chemical tests for vitamins A and D, there is no effect as production of A in ergosterol alone, but some as D. When it is combined with cod-liver oil, there is a marked increase in both A and D over either alone, it having more effect on D

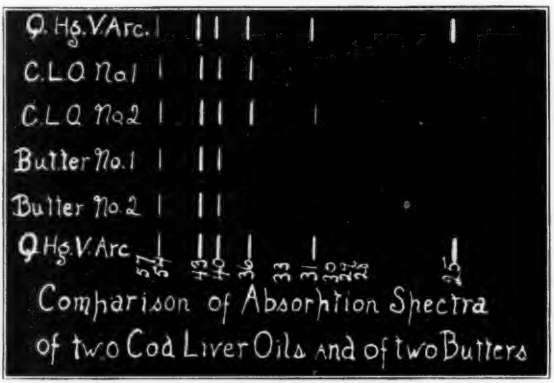


Fig. 12.—Difference in the spectrums of different cod-liver oils and butters.

advances has been made by Rosenheim and Webster.[8] Their evidence seems to identify a sterol known as ergosterol with vitamin D. This substance has been shown to prevent rickets in rats in dosages of one ten thousandth milligram, and to have an absorption for ultraviolet 2,000 times as great as cholesterol for the same bands of the spectrum.

8. Rosenheim, D., and Webster, T. A.: Photochemical Production of Vitamin D from Ergosterol, Lancet, 2:622 (Sept. 17) 1927.

than on A. Here, again, we have a marked difference shown in the effects produced by different bands of the spectrum as regards increasing or decreasing the amount of both A and D vitamins. It is important to note that cod-liver oil alone showed a marked increase in D in quartz tubes bathed in bands 4360 and 3660A.

As a further study of its effect as compared with that of other activators, ergosterol was injected intravenously by dissolving about 1 mg. directly in 1 c.c.

of a rabbit's serum and noting the changes in both the levels of certain chemical constituents and the spectrums of the blood. Figure 14, *A* and *B*, shows the latter, and in *A* also, for comparison, the effect on the serum of activating it before injection, which removed band 3130 and added band 4046. Thirty minutes after injection of this small quantity of ergosterol (less than 1 mg.), blood was taken for testing, and again in two hours and sixteen hours. In both the half-hour and two-hour samples, new bands appeared at about 5100 and 3391. Sixteen hours after injection of the ergosterol, the serum had the same spectrum bands as before the treatment. The chemical changes in the blood accompanying the procedure, shown graphically in Figure 15, reveal a marked drop in total serum calcium and in diffusible calcium and a slow return toward normal. The rabbit was large, 3,670 gm., and the amount of blood drawn, or the

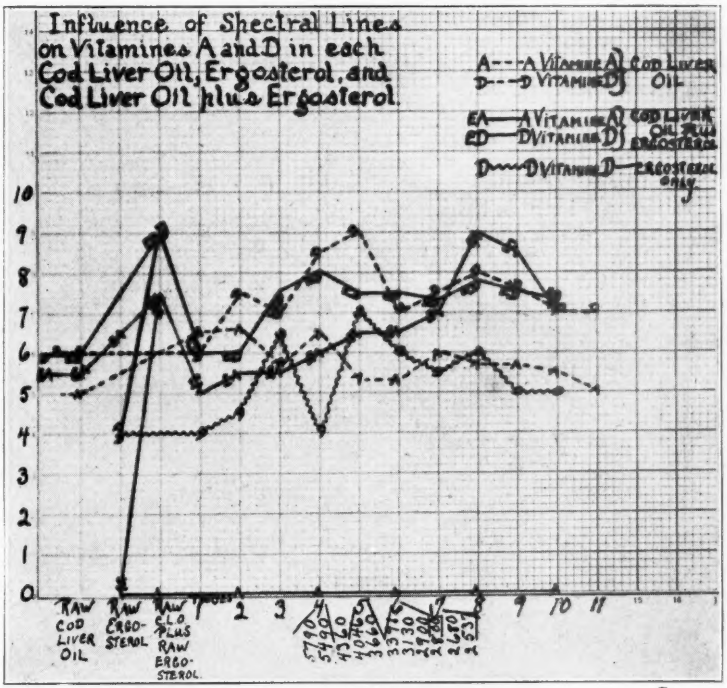


Fig. 13.—Comparison of the influence of different bands of the spectrum on vitamins A and D in cod-liver oil and ergosterol, separately and together.

Since, as indicated by the preceding data, the effect of activation on ergosterol is chiefly shown when it is in contact with such substances as milk or blood, the foregoing test was repeated

forty hours after the first test, with the following results. The total calcium fell only about 0.4 mg. instead of 2.0 mg. in the preceding test, when the ergosterol and the blood serum, in which 5.8 to 7.3 mg., with a corresponding decrease in the nondiffusible calcium from 8.1 to 5.1. This, it will be noted, is a reversal of preponderance, which was carried through the two-hour period,

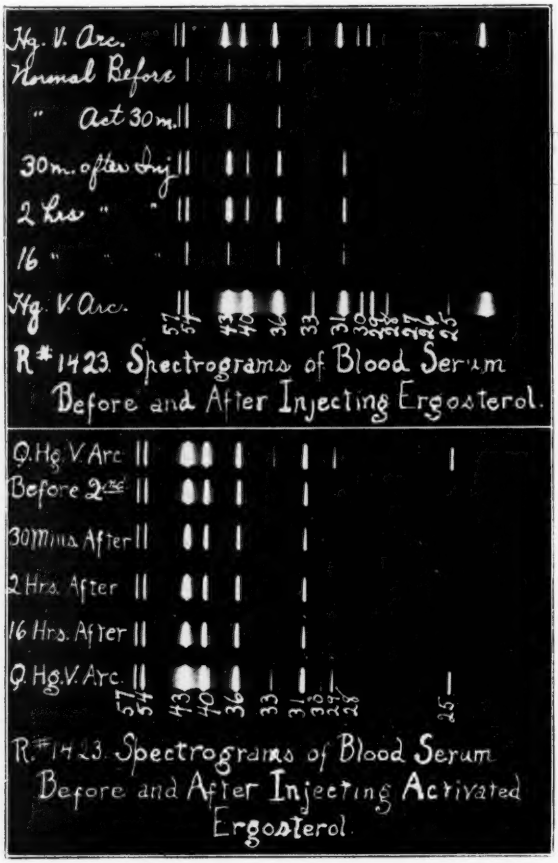

Hg. V. Arc.
Normal Before
" Act 30m.
30m. after Inj
2 Hrs " "
16 "
Hg. V. Arc.
57 54 43 40 36 33 31 28 25
R* 1423. Spectrograms of Blood Serum Before and After Injecting Ergosterol.
Q. Hg. V. Arc
Before 2nd
30 Mins. After
2 Hrs. After
16 Hrs. After
Q. Hg. V. Arc.
57 54 43 40 36 33 31 28 25
R.* 1423. Spectrograms of Blood Serum Before and After Injecting Activated Ergosterol.

Fig. 14.—Comparison of the blood spectrums in successive periods after the injection; above, of raw and, below, of activated ergosterol.

it was injected intravenously, were not activated; and whereas, in the former, the diffusible calcium fell from 6.8 to 5.2 mg., in this case it was raised from and, at the end of sixteen hours, had not come back to the ratio at the beginning of the test. The total calcium remained nearly constant, and marked changes

occurred in the ratio of diffusible and nondiffusible calcium.

This is strikingly illustrated in the graph showing these two series, Figure 15 *B*. Even more striking is the change in the spectrographic record. (Figure 14 *A* and *B*.) In the first place, the blood has changed so that the normal nearly complete of 3130, with complete absorption beyond. A further marked difference is that, after the treatment, the blood remained the same as before the treatment. A comparison of the effect of activating the serum alone will be given in a more detailed report. A comparison of these blood changes as they

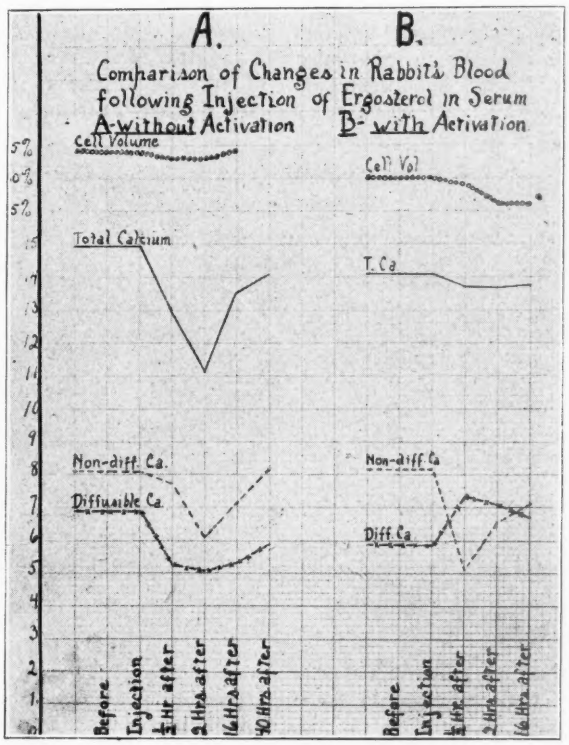


Fig. 15.—Blood chemical changes associated with the spectral changes of previous figure.

(before the second treatment) has practically no absorption from 3130 toward the longer rays and complete absorption beyond, including 2537; whereas, before the first treatment, there was complete absorption of bands 4046 and 3391 and occurred in these two experiments is shown graphically in a comparison of *A* and *B*. (Fig. 15.) The application of these new data is being made to practical cases by recording spectral conditions before and after operations for the

removal of focal infection and treatment.

The effect on the absorption of bands of the spectrum when ergosterol is added to serum is shown in Figure 16, in which raw serum is shown to have a different absorption of the spectrum from that of activated serum. The more concentrated solution of ergosterol absorbs practically all bands except a small part of 5400 and 4300. The addition of a very small amount of ergosterol to serum changes quite markedly the absorption distribution and makes it, in some samples, like that of normal serum when energy of these particular bands is concerned. The length of the period of radiation was not great enough to destroy the ergosterol or vitamin D.

In this connection, it is important to note the succeeding effects on the blood of an animal when it is exposed to ultraviolet radiation for an extended period of time, four hours and forty-five minutes, which are graphically shown in Figure 17. The cell volume was reduced from 35 to 15 per cent in a period of two days. The total calcium increased nearly 2 mg. and was maintained

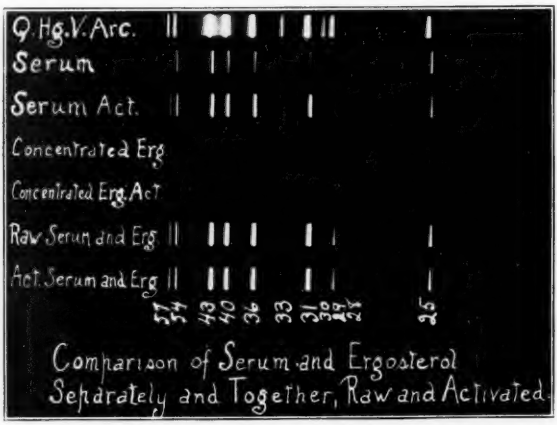


Fig. 16.—Spectrograms of serum and ergosterol alone and together, raw and activated.

activated, which it has here. The presence of the ergosterol seems to satisfy certain elements in the serum so that they do not now absorb the radiant energy. It is quite important to observe that, while the range of absorption is not extended by the presence of the ergosterol, the intensity of the absorption is not so great as when it was absent; that is, the lines are stronger. The serum seems to be satisfied, or, in a sense, in equilibrium, as far as the radiant at the high level during the period of irradiation, but dropped in the first twenty-four hours to nearly 1 mg. below its starting point, and during the next twenty-four hours, came back to a level about 1 mg. above its starting point. Practically all this increase was in diffusible calcium, as will be seen from that line, the nondiffusible ending at a lower total level and the diffusible at a level about 2 mg. higher than at the beginning of the test. The effect on the inor-

ganic phosphorus was a progressive depression during the period of irradiation, both plasma phosphorus and cell inorganic phosphorus returning to about their original level two days after the treatment.

I have previously reported[9] the ten-

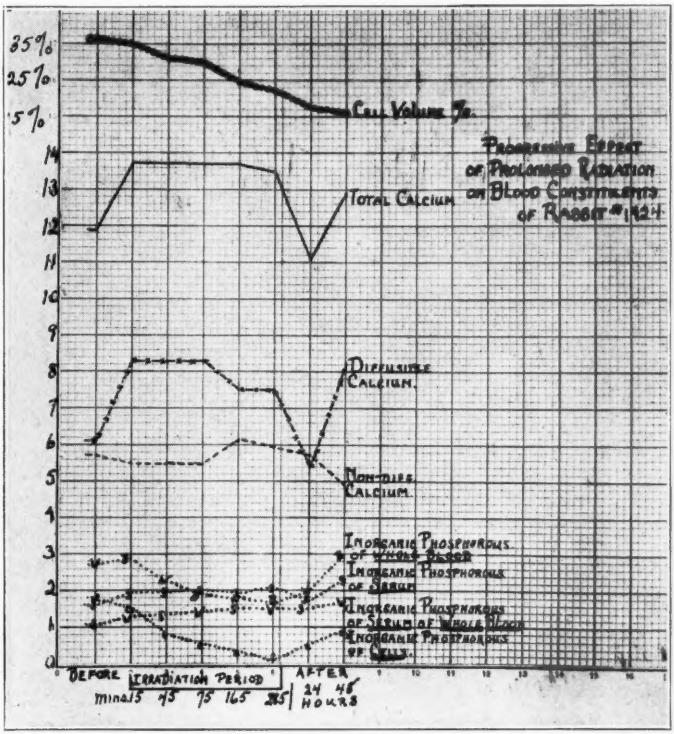


Fig. 17.—Changes in blood calcium and phosphorus factors produced by exposing a rabbit with hair clipped from the back to full quartz mercury vapor arc with blood determinations made as indicated.

dency to leukopenia lasting several days after a mild leukocytosis lasting only a few hours, as a result of exposure to ultraviolet radiation. This was accompanied by a marked decrease in polymorphonuclears and increase in small lymphocytes. Others have reported similar findings. These data seem to indicate strongly that our problem is not primarily one of exposing individuals to ultraviolet radiant energy as it may come from such artificial sources as the quartz mercury arc or carbon arc, but that the radiation must be limited to that which will be helpful, and to determine the greatest need of the individual, it is im-

9. Price, W. A.: Dental Infections Oral and Systemic, Cleveland: The Penton Press Co., Vol. I, chap. 27, 1923.

portant to know, in the light of information at present available, the diffusibility of the blood, since the full spectrum of the mercury vapor arc and carbon arc tend to increase the diffusible factor unduly. This stresses the need for filters for such artificial sources of ultraviolet radiation and for a removal from our dwellings, where feasible, of the glass filters of the type that we now employ.

Figure 18 shows the transmission of various glasses. The top and bottom show the transmission of quartz unobstructed. The second, "Corex," transmits to and including the strong band 2537, though it absorbs part of it and some to 3660. "Vitaglass" begins absorbing strongly at 2800. It only transmits a part of the radiations at 2900 and 3000. "Quartzlite" transmits very little beyond 3100 and only part of 3100 and 3300 bands. Window glass transmits only to about 3600. All of these glass substitutes have a great advantage over ordinary glass. However, practically all absorb some of the radiation that is desirable. Our atmosphere does not permit radiant energy to pass quite to 2900, and much less than this at times, even at most of the time in some locations. Our bodies were not intended to receive the extreme ultraviolet radiation and it is probable that most, if not all, people would be better not to have radiation much, if any, beyond 2900, though considerable is needed from 2900 to 3300. It is my opinion, based on these data, that a filter should be used for such artificial sources of radiant energy as quartz mercury arc and carbon arcs to limit the radiation to approximately that from the sun until further researches, particularly along spectral lines, shall reveal the bands that should be indicated for correcting special abnormal conditions;

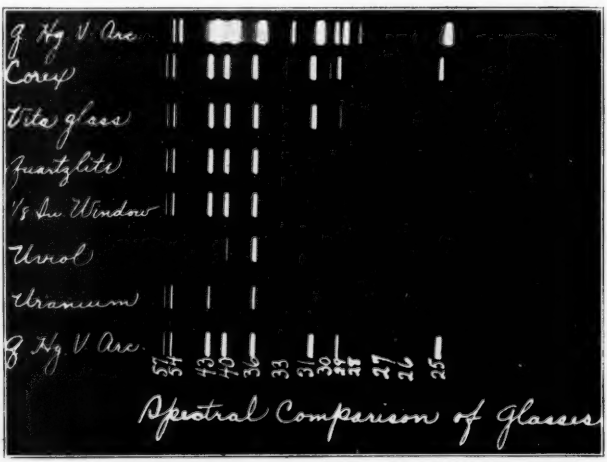


Fig. 18.—Ranges of transparency to ultraviolet rays of several glasses. The first three are available as substitutes for window glass. The sun spectrum goes to about 2950 and substitutes should transmit freely to that band.

which I believe will soon be achieved.

We have not realized how rapidly haze or humidity reduces the ultraviolet end of the spectrum. Figure 19 shows sections from films from my clock-driven attachment which makes spectrums at regular periods as desired; in the film shown, every five minutes. *1* shows the apparently clear sky, with variations due to drifting moisture or clouds. *2* shows the effect of haze, the sky still looking quite bright. *3* shows the effect of light clouds. Note that the loss begins at the ultraviolet end of the spectrum. Applying these data to practical utilization, where the diffusible calcium is too high, avoid ultraviolet radiation of the shorter wave lengths and do not give activated cod-liver oil. My researches indicate that administration of raw cod-liver oil tends to raise the nondiffusible calcium and depress the diffusible calcium and that administration of activated cod-liver oil and exposure to radiant energy to 2800 tend to raise the diffusible calcium. Some of the bands beyond 2900 have distinctly harmful effects.

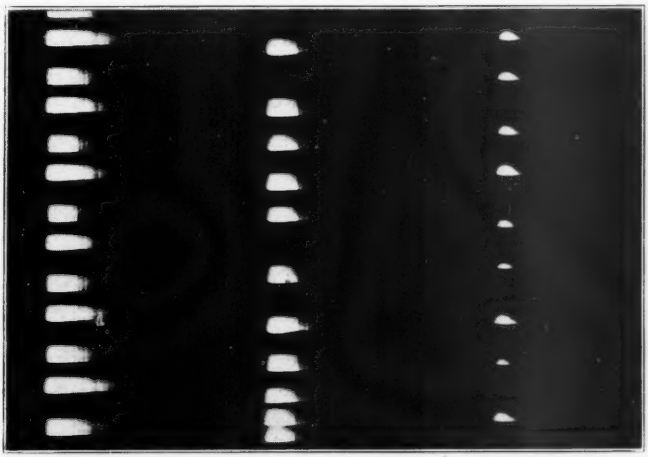


Fig. 19.—Specimen of spectrums made of sky at five-minute intervals by the recording attachment, which shows the effect of water vapor in absorbing chiefly the ultraviolet rays. This demonstrates the depressing effect of overcast cloudy or smoky sky. *1*, clear sky. *2*, beginning haze. *3*, light cloud.

In a previous communication,[1] I have shown that exposure of cod-liver oil to irradiation from the sun or an artificial source changes it so that there is increased fogging of a photographic plate placed over it, not by radiation being given off from the surface of the oil but rather by the production of a gas, probably hydrogen dioxid, and, further, that the increase in this oxidizing agent is about proportional to the time of irradiation. I have also shown previously that oil so treated had an enhanced capacity for producing biologic reaction. If ergosterol or a similar substance is the active agent in butter fats and animal oils which increases calcification processes, and if the photographic fogging is related to these properties, it might be expected that adding ergosterol to cod-liver oil would enhance this factor. This

TABLE 2.—BLOOD CHEMICAL STUDIES OF INDIVIDUALS WITH OVERLOAD OR PHYSICAL DISTURBANCE*

	Total Serum Calcium	Cell Calcium	Diffusible Calcium	Nondiffusible Calcium	Sol. for Ca. Serum Plasma	Serum Inorganic Phosphorus	Calcium Balance	Polymorphonuclears: Small Lymphocytes
Case 1436: Xerostomia and arthritis (severe).	9.53	0.98	3.64	5.89	5. ..	1.45	−26.2	61/31
Sixteen months later—marked improvement	9.59	1.57	4.47	5.12	10 30	5.93	+16.82	55/30
Case 1772: Pregnancy, fourth month.....	10.68	2.65	7.67	3.01	7 17	3.14	− 6.4	71/22
Sixth month—lassitude, treatment commenced.....	10.01	2.15	5.40	4.61	10 42	2.08	− 19.2	73/19
Eighth month—marked improvement	11.16	1.01	5.82	5.34	6 28	3.66	+ 0.80	79/17
Case 1736: Polyneuritis (bedridden).....	11.73	0.13	8.23	3.50	7 22	2.72	− 8.00	62/23
Two months later—improvement.....	10.06	2.15	6.50	3.56	6 19	3.14	− 8.42	33/56
After six months—marked improvement	10.65	2.62	5.85	4.80	10 35	3.16	− 6.30	74/13
Case 1546: Arthritis.	10.41	.....	3.75	6.62	..	3.78	+ 2.2	52/39
Five days later—improvement.....	10.52	.....	4.21	6.33	.. ..	3.26	− 9.3	56/33
Two years later—improvement.....	10.01	3.03	6.78	3.22	10 13	3.92	− 0.80	54/34
Case 1695: Dizziness, hypertension.....	10.5	0.10	3.20	7.30	8. ..	2.74	− 11.1	48/45
Three months later—improvement.....	10.2	1.40	2.30	7.90	6. ..	3.34	− 5.0	40/41
Nine months later—marked improvement	10.93	1.50	6.28	4.65	7 23	4.48	+ 9.0	44/38
Case 1710: Ununited fracture.....	11.05	1.10	5.29	5.76	9 30	3.12	− 5.50	59/32
Three months later, preparing for operation.....	10.48	.....	5.92	4.56	8 ..	3.25	− 5.40	.....
After fourth month—operation.....	11.64	3.39	4.43	7.21	6 19	3.10	− 3.92	64/25
After fifth month—complete union.....	11.32	3.35	5.42	5.90	8 16	3.60	0.75	60/31

*Marked changes in blood calcium levels associated with improvement following treatment.

has been tested, and the results are shown in Figure 20. It is clearly seen that, in every step from a comparison of raw cod-liver oil and raw cod-liver oil containing a trace of raw ergosterol to activation of this combination for various periods up to 100 minutes, there is marked increase in fogging of the photographic plate, as was to be anticipated from the association of this phenomenon with other factors previously associated and reported. We are now testing the relation of these phenomena to various vitamins, particularly A, C and D, separately and combined.

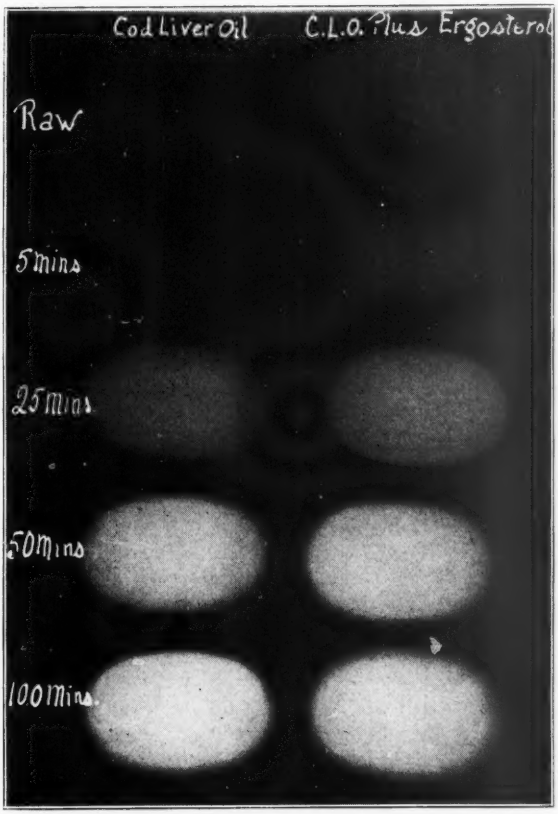


Fig. 20.—Greater fogging effect of cod-liver oil containing a very small quantity of ergosterol than of cod-liver oil alone as a result of exposure to the ultraviolet rays for varying periods of time.

For several years, I have been treating disturbed calcium metabolism both on experimental animals and in practice by the use of activators, and it is of interest here to note some of the clinical

results in the light of the blood chemical studies and in the light of the new experimental data being presented here. A little more than 1,500 blood chemical studies have been made on patients, most of them affected with degenerative disease in some organ or tissue, which, in the light of the newer knowledge, may be related directly or indirectly to focal infections, such as dental.

A large number of animal studies have also been made to throw light on these processes. In Table 2 will be seen a series of blood chemical studies on six patients. Note particularly the shift toward normal of the level of equilibrium between diffusible and nondiffusible calcium, also the changes in cell calcium, inorganic phosphorus and calcium balance. These have been given by about a 5 gm. capsule of cod-liver oil with each meal, which has been raw or activated in accordance with the balance between diffusible and nondiffusible calcium, and have had calcium lactate with it or not, in accordance with the evidence of wastage of calcium, as shown by the urine calcium and the study in every case by roentgenograms of the texture of the bone with regard to tendency to general calcification or decalcification. The cod-liver oil has been activated, as previously reported, by exposure to sunshine (not from an artificial source), from one to fifteen minutes, according to the time of the year and the patient's apparent need as indicated by the faulty equilibrium between diffusible and nondiffusible calcium. Space does not permit of an extended analysis of the clinical history. The first patient could walk only with great difficulty, owing to polyarthritis, associated with xerostomia (dry mouth), which, according to the literature, is expected to be progressive and is nearly always fatal. The patient can now produce from 10 to 20 c.c. of saliva in about half an hour and can walk without even a cane. She has received activated cod-liver oil, size No. 0 capsule (about 0.5 c.c.) and one 5-grain tablet of calcium lactate with each meal.

The second patient received mixed capsules, part raw and part activated cod-liver oil, and one 5-grain calcium lactate tablet. These patients have all also received an ample supply of vitamin C and iron from citrus fruits, vegetables and salads.

Note the great change in these two cases in calcium balance. Most patients apparently do not need calcium lactate. The last case is particularly significant. An ununited fracture of four years' duration with a history of one unsuccessful operation has had a perfect healing with an operation performed after preparing him for it. The clinical aspect will be reported in detail in the near future. These cases are presented here as illustrations both of the procedure and of the effects.

SUMMARY

Data have been presented which I interpret as follows: 1. Calcium in milk, blood and many biologic fluids, which exists partly as diffusible and partly as nondiffusible, can readily be treated so as to change the percentages of diffusible and nondiffusible, by several means, including irradiation or shaking with raw cod-liver oil and with activated cod-liver oil.

2. The effect of activation of the cod-liver oil changes it so that, whereas raw cod-liver oil in several fluids reported lowers the diffusibility of the calcium, activated cod-liver oil increases the diffusibility; which is also the effect of direct irradiation of the same fluid with the same irradiation.

3. The administration of raw and activated cod-liver oil produces, in general, the same effect in blood serum as by shaking the fluids together.

4. The effects of different parts of the spectrum have been shown to be different for certain various lengths of rays.

5. These characteristic differences are produced both by irradiation with different bands and by shaking the fluids presented with cod-liver oil which was irradiated with these same bands.

6. The irradiation of vitamin D in milk when different parts of the spectrum are used separately, with regard to the shift in diffusibility of calcium, has a general similarity; which suggests a direct association. A study of the effects of irradiation of fluids compared both with the effects of administration of the sterol egosterol, separately and in association, gives evidence of its being similar in effect to, if not directly associated with, the diffusibility phenomena presented.

7. Results of the use of the spectrograph for the study of blood serum and other body fluids indicate its great value in both research and diagnosis.

8. These data are related to the practical problems of obtaining the required amount and kind of irradiation by the use of suitable substitutes for glass.

9. The relation of these phenomena to some of life's problems seems to indicate that herein is an important step forward both in the understanding of bone and tooth formation and disease and the means for the forming of better hard tissues and the prevention of subsequent disease in these tissues.

8926 Euclid Avenue.

CANCER OF THE MOUTH*

By A. T. RASMUSSEN, D.D.S., La Crosse, Wis.

CANCER remains the scourge of middle and later life. While research workers have worked incessantly in their efforts to find the real cause of cancer, with now and then a ray of light appearing, the problem of its etiology remains unsolved.

During the World War, approximately 80,000 American soldiers lost their lives from all causes. During the same period of time, about 180,000 Americans died from cancer.

Cancer is no respecter of persons. The high and the low, the rich and poor, of both sexes, are victims of the disease. It attacks all parts of the body, and the length of its course depends only on the particular type of cancer, and the vital importance of the organs or parts involved. If the disease is unchecked by outside interference, the result is always fatal.

In the light of present-day knowledge, it may be said that it is not contagious or infectious. Neither is it transmitted from parent to child. In other words, it is not inherited, although there is some evidence that there may be an in-

*Read before the Section on Oral Surgery, Exodontia and Anesthesia, at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 21, 1928.

herited susceptibility to cancer in man as shown by experiments with mice.[1]

It is not something foreign which is introduced into the body. It is an uncontrolled and unorganized proliferation of cells, more or less modified, but such as are normally found in the various tissues of the body.

All cells of the animal organism normally function according to a well-planned and well-governed scheme of things. When cells revolt, so to speak, break the bonds that hold them under control and proceed to reproduce themselves without regard for the well-being of other cellular structures, persistently invading such other structures just as far as the increasing size of the parasitic cell colony demands; when they produce nothing, but live off the efforts of other cells; when they have ceased to be producers, and become a mob of uncontrolled destroyers; when they rapidly reproduce, only for the purpose of reproduction, then we have a cancer.

Let us carry the analogy a little further. Whenever any group of individuals bent on the destruction of society, for their own aggrandizement, reach a certain stage in their growth, they invariably fall victim to their own viciousness, and murder, pillage and other destructive agencies run rampant within their own ranks.

Just so with cancer. It reaches a place where the cells of which it is composed die and break down, and sloughing follows as a result of its own activity, while the remaining cancer cells apparently take on greater activity, invading the surrounding tissues even more rapidly than before. If memory serves me correctly, it was Emil Beck, of Chicago, who suggested that cancer might be just normal cells that have turned Bolshevik.

As clinicians, we are, of course, not in position to furnish the world with scientific information on the etiology of cancer, or on the comparative value of the various methods and means advocated for the treatment of it. We are in the best position in the world to observe the manner in which it makes its appearance and growth. The former is largely a matter for the laboratory worker to solve, while the latter must be the work of the clinician.

The dentist is the guardian of the gateway to the system, the oral cavity. While this has been said many times, I fear that too often the fact is overlooked that dentistry is a branch of general medicine or, if you please, one of the branches of the healing art. Forgetting this fact, too many members of the dental profession have contented themselves altogether too much with looking for cavities in teeth or, shall I say it? an opportunity to construct artificial dentures, or perform other replacement operations.

Important as these are, they are not the most important, and the dentist who loses sight of the bigger things, i.e., the general health and well-being of his patient, is not living up to the highest ideals of his profession.

While not all members of the dental profession or any of the other branches, or specialties, of the healing art, and by no means all general practitioners of medicine, are, or will be, equipped, either by inclination or training, to treat cancer cases, I want to say with all the emphasis at my command that any one professing to treat disease of the human body who does not so inform himself as to be familiar with the early symptoms of cancer, and who does not sound the proper

1. Slye, Maud: Biological Evidence for the Inheritability of Cancer in Man, J. Cancer Res., 7: 107 (April) 1922.

warning, is guilty of negligence in his duty to those who, having confidence in him, place themselves, or their loved ones, in his hands for treatment.

Briefly stated, the difference between a benign and malignant neoplasm is this: A benign growth is self-limiting, while a malignant one knows no boundaries, and destroys life by invading healthy structures.

Cancer is always a purely local lesion to begin with. Don't forget that.

According to Doctor Wood,[2] director of cancer research at Columbia University, all malignant neoplasms, grouped collectively as cancer, may be classified into three important groups or types, according to the tissues from which they originate. According to his classification, epithelioma is the type originating from the epidermis; carcinoma, from the glandular structures; sarcoma, from connective tissue.

As the glandular structures are of epithelial origin, it would seem that this classification could well be narrowed down to two main types; carcinoma, of epithelial origin; and sarcoma, arising from the connective tissues. Many subdivisions are made of these types, a discussion of which is beyond the limits of this paper.

All of these types of cancer are found in and about the oral cavity. Cancer may attack the lips, cheeks, gums, palate, floor of the mouth, pillars of the fauces, tonsils, tongue or the bones of either jaw. Any abnormal growth, anywhere about the mouth, should be viewed with suspicion from its very beginning. Some are cancers. All are potential cancers. So with any ulcer, or sore, that does not heal promptly. A discharging fistula, or sinus, anywhere about the mouth may be the outward sign of a deep-seated cancer. I have a case under treatment now in which such a sinus had been discharging on the palate for several years, having been surgically cauterized, curetted and otherwise treated a number of times before it came under my observation. A biopsy definitely established a diagnosis of carcinoma. That this patient will die as the result of cancer there is scarcely a doubt, although, as a result of several radical operations, his life has been prolonged for several years.

2. Wood, F. C.: Cancer, Encyclopedia Americana, 5: 490, 1928.

PREVENTION VS. CURE

Dental literature is replete with writings on the subject of prophylaxis. In no other disease is prophylaxis more important than in cancer. It is far better to prevent a cancer than to attempt a cure.

Any chronic irritation, of whatever nature, is a potential cause of cancer. Not all irritations result so seriously, but many do. Long before there exists any visible signs of irritation, the dentist should recognize the things that may become an irritant. Broken down teeth; sharp edges of teeth, resulting from wear; ill-fitting dentures; artificial crowns and bridges, poorly fitted or contoured; hot pipe stems; irritating drugs; cigaret or chewing tobacco, habitually used; leukoplakia, etc.; these and other things may lead to chronic irritation and cancer. It is the business of the dentist to be on the lookout for such things and to see that the cause is removed.

Cancer of the mouth is much more frequent in men than in women. It frequently arises at the site where the patient has habitually held a pipe stem or quid of chewing tobacco.

Of 376 cases reported by Simmons,[3] 87.5 per cent occurred in men and 12.5 per cent in women. Eighty-five per cent used tobacco in some form, most of them smoking, while some chewed, and a few used snuff. It was not uncommon to find cancer of the cheek on the side of the mouth where the quid was held.

Moier[4] reports a series of 204 cases of carcinoma of the mouth, 189 in men, and fifteen in women. The average age when treatment was applied for was, in men, 56½ years; in women, 51 years. The youngest was 29 years, and the oldest 75.

In 376 cases, Simmons[3] makes note of the condition of the teeth in 154. One hundred and sixteen of these are described as bad, and, in twenty-eight cases, the patient himself dated his first symptoms as arising from wearing a denture or bridge.

The same writer found leukoplakia in 14 per cent of this series of cases. It is a well established fact that leukoplakia is a precursor of cancer. Bloodgood[5] says there is but one cause of leukoplakia —tobacco in some form. Note the relation between the use of tobacco and cancer.

Always keep in mind that a growth, ulcer or fissure that today is benign may undergo malignant degeneracy and be a serious menace to the life of the patient before we have another opportunity to see it, and warn the patients of such possibilities. When you have done this you have shifted the responsibility to the patient's own shoulders, should he fail to heed your warning. Unless you do this, you must assume the responsibility yourself. How, I ask you, are you going to square yourself with your own conscience, or the patient, when he finds that a cancer has developed, and the accusation is hurled at you that you failed in your duty?

DENTIST AS A TEACHER

Remember that our duty is not all in the way of treating disease. It is as much that of a teacher. The dentist who fails to teach his patients the importance of prevention, especially as it applies to this dread disease, is failing to grasp the highest privilege that is his. I am sure that I speak for everyone who has had any experience in the treatment of cancer, in any of its forms, when I say that there is a thousand times more satisfaction in the knowledge that a possible cancer has been prevented than there is in our efforts at curing the disease, once it has become established. I am not belittling the thrill one gets at the thought of having been instrumental in establishing a cure in such cases as come to us early enough; but, unfortunately, too ofen the case is too far advanced when it reaches the surgeon, and the patient dies as a result of the disease in spite of all that can be done for him.

I have stressed chronic irritation as a predisposing cause of cancer. There is something more than irritation involved, for by no means all such cases develop malignancy. There is some law, or principle, of biology involved which, at the present time, we do not understand. Why one develops a malignant neoplasm, while another, under apparently the same conditions, does not, is something which we cannot tell, but it is a well

3. Simmons, C. C.: Cancer of the Mouth: Results of Treatment by Operation and Radiation, Surg. Gynec. Obstet., 43:377 (Sept.) 1926.

4. Moier, P. J.: Treatment of Carcinoma of the Mouth, Practitioner, 118, March, 1927.

5. Bloodgood, J. C.: Early Recognition and Treatment of Lesions of the Oral Cavity, Rev. Clin. Stomatol., 2, January, 1925.

established fact that irritation predisposes to cancer.

This is well illustrated by the fact that women of the white race rarely develop cancer of the cheek, while those of the Philippine Islands, Ceylon, Siam, India and other Eastern countries, who habitually chew the highly irritating betelnut, often carrying a quid of this inside the cheek day and night, frequently suffer from cancer of the cheek, beginning inside the mouth.

Does this point to the probability that, in the near future, we are going to be called on to operate on more cases of cancer of the mouth as a result of the increasing use of tobacco by our women? I fear that it does. You fathers will do well to weigh the possible results carefully before you sanction or condone the use of tobacco by your daughters. I am not posing as a reformer, but we might as well look the problem squarely in the face.

In view of the foregoing, therefore, until science has found the real cause, and uncovered the biologic laws that govern the origin and growth of cancer, we must content ourselves with our efforts to remove any and all things that we know to be contributing causes, together with the very early recognition and treatment of the disease, once it has made its appearance.

That our efforts at educating the public along these lines are worth while, is evidenced by the fact that the average length of time between the first symptom that is noticeable to the patient, and the time of consulting the physician or specialist, has been markedly reduced. Further, the time elapsing between the first visit of the patient and radical operation has been reduced from 65 to 70 per cent.[6] In the light of present-day knowledge, these periods should still be materially reduced.

TREATMENT

Many things have been suggested for the cure of cancer. Some of these remedies have been given wide publicity through the public press. Others have been legitimately suggested through the scientific publications, while the charletan has grasped the opportunity to mulct the easy victim who is unfortunate enough to be suffering from this malady, by making wild promises of cures through some means "known only to himself."

The latest remedy that has been scientifically suggested is colloidal lead. While there seemingly was some ground for hoping that it would prove of real benefit, from the most recent evidence it seems that we are again to be disappointed. There is nothing startlingly new to announce in the way of a remedy or cure, nor yet as to its etiology. For this, we must live in hope, each of us adding such fragmentary bits of information as we can to the accumulating store of knowledge.

The treatment of cancer, then, consists essentially of a thorough removal of the growth. Where this can be accomplished, and the operation done early enough, a cure may be expected. The tendency to early metastasis makes it imperative that no time be lost. All cancers of the mouth metastasize to the cervical chain of lymphatics and the thoracic cavity. It is therefore important that the cervical glands be removed or be treated by means of roentgen rays or radium to guard against a recurrence here.

6. Pfahler, G. E.: Early Diagnosis and Treatment of Cancer, Atlantic M. J., February, 1927.

Various methods of operating suggest themselves. The knife, the actual cautery, electrothermic coagulation; all have their place, and the choice must be left to the surgeon. It may be said on general principles that electrothermic coagulation offers the most encouragement, and probably is the method of choice in most cases, because of the destruction of the cancer cells that occurs, and the sealing of the blood and lymphatic vessels, thereby guarding against metastasis resulting from the operation. Of course, there are times when a combination of two or more of these methods are used to advantage.

Radium has its place. Many cancer patients have reached a stage where the case is inoperable, owing to the structures involved. Here, radium finds a place, sometimes with good results. At other times, it may be used after radical operation. There are various ways of using it. Properly screened, it may be applied on the surface for superficial growths or in treatment of the cervical glands. It may be buried deeply within the growth for a period of time, in the form of needles, or radium emanation "seeds" may be buried in the tumor and removed when their emanations have been exhausted, or left to become encysted in the tissues.

The use of roentgen rays in the treatment of the glandular structures has already been referred to following radical operation for removal of the cancerous growth. This, I believe, is their most valuable place, in our fight against cancer.

As this paper is intended as a plea for the cooperation of those in general dental practice in our efforts to reduce the ravages of cancer rather than a technical treatise of the subject, I am not going more extensively into the subject of differential diagnosis or the technic of treatment. I realize that most of you will not make the final diagnosis nor treat the cases coming under your observation. Those who are interested in this phase of the question are referred to the literature. To give even a brief review of that would require much more time than is at our disposal, and is a fit subject for a paper in itself.

It may be said that, viewed in the light of the present, it appears that the results of any treatment depends more on the amount of differentiation of the cells than on any other one factor; in other words, on the malignancy of the growth. Further, as soon as there is any clinical evidence of metastasis, the chances of a permanent cure are materially reduced.

Therefore, early diagnosis and radical treatment offer the only hope of eradicating the disease.

With the facts as they are, and until further light is cast on the subject, it remains for all branches of the healing art to be ever on the lookout for any abnormal condition, anywhere in the body, that might lead to the development of a cancer.

Bloodgood[7] is right when he says: "Physicians [including dentists] should know the real facts about the results in the operative treatment of cancer; if they do, they will realize that *the percentage of cures of cancer depends today more on improvement of the method and extension of the education of the public and the profession,* than on any extension of the operation or improvement in the treatment with roentgen rays, or with radium."

7. Bloodgood, J. C.: Facts in Regard to Cancer of the Tongue, J.A.M.A., 85: 537 (Aug. 15) 1925.

The same writer, I believe, has said that cancer of the mouth is almost always a preventable disease. If this be true, what a pity it is that so many suffer from it, going to a premature grave in such a large percentage of cases.

While the average dentist, at the present time, will not treat these cases, even in the precancerous stage, I pray you study the normal conditions of your chosen field, so that you may quickly recognize any abnormality in and about the mouth, and immediately refer the patient to the oral surgeon, or other specialist who is in a position to give the patient the benefit of present-day knowledge as it pertains to cancer. Do not wait until it is too late. Members of the dental profession can do much toward reducing the high mortality rate from cancer. Will they do it?

211-12 Linker Building.

DISCUSSION

Harvey D. Barnett, St. Paul, Minn.: Dr. Rasmussen should be congratulated first for limiting his paper to knowledge which is practical to the general practitioner. So many times a man, well versed in a specialty, when attempting to bring his work before others who are not interested in the details, wearies his audience with the details, until the main issue is lost sight of. By leaving out the technicalities of classification, microscopic differences in different classes of tumors, operative technic, etc., he has accentuated the thought which is most valuable to us. His analogies in describing the general character of this disease help us to have a clearer conception of what the nature of cancer is. The importance of us all having sufficient knowledge of cancer that we may early recognize it and sound a proper warning cannot be overemphasized. We must be ever alert to recognize early symptoms and points of possible chronic irritation. Where the habitual use of tobacco is manifested, let us be doubly alert for symptoms. I should like also to emphasize Dr. Rasmussen's point on having a thorough knowledge of the appearance of normal conditions, for without such knowledge, slight variations are not recognized. It might be well, since so many think that cancer never appears before the age of 40 or 50 years, to add that sarcoma may appear at almost any age. Fortunately for us, this type of cancer seldom results from irritations of crowns, plates, broken teeth, etc., such as may cause carcinoma. Dr. Rasmussen did not mention roentgen-ray findings. Very often in interpreting our dental roentgenograms, we are so engrossed in our efforts to find caries and rarefied areas, at root apices, that we neglect to note carefully the character of the bone in the body of the maxilla or mandible, as the case may be. In most cancerous lesions found in the mouth, the roentgen ray affords little aid on positive diagnosis. It often contributes some evidence to arouse suspicion where such conditions are present. In cases of cysts, which are included under odontomes in tumor classifications, the diagnosis is often made positive by the roentgen ray. This is also true of osteoma and composite odontomes. Therefore, I should like to emphasize the importance of careful, thorough examination of dental roentgenograms.

THE PATHOLOGY OF THE SOFT TISSUES OF THE MOUTH DURING CHILDHOOD*

By F. BLAINE RHOBOTHAM, D. D. S., Chicago, Ill.

ONE of the strangest phenomena in the study of living tissues is exhibited in the mouth. The lining of the mouth is rich in nerve supply which, while quite insensitive in health, is supersensitive in disease. Perhaps there is no tissue in the body that heals so quickly or is so generally resistant to disease. During childhood the mouth, like all other areas of the human body, displays great susceptibility, which is partially compensated by an accelerated recuperative power.

At birth, the oral tissues are usually free from disease. Rare instances of gonorrheal infection have been reported, although, generally, the mucosa of the mouth is resistant to that type of bacterial infection at any age.

Marked clefts of the palate in early life are the source of irritations that require special care prior to successful closing by operative procedure.

Infants frequently suffer from "thrush," which is a form of spreading membranous stomatitis caused by the superficial growth of a fungus, *Oidium albicans*. It begins on the tongue and mucosa of the cheeks, usually from acid fermentation of milk and starchy foods. Strict hygiene and corrective diet, particularly in debilitated children, brings about a rapid recovery.

There has been so much misunderstanding regarding the cutting of teeth in infancy that I take the liberty to quote L. Emmett Holt, authority on pediatrics:

> In healthy children there is very often fretfulness and poor sleep for two or three nights; there may be loss of appetite so that only one half the usual amount of food is taken; there is salivation or drooling and often slight fever; there may be some symptoms of indigestion, such as vomiting or the appearance of undigested food in the stools. In delicate children all these symptoms may be much more severe. Temperature of 100-102 indicates a mild illness in infancy; 104 or more indicates something more serious.

The temperature is not so indicative in the child as in the adult.

Tumors, benign or malignant, are not common during childhood, although even carcinoma has been reported. They are so infrequent that they will not be considered in this paper.

Aphthous stomatitis is common in poorly nourished children during teething and after acute and weakening diseases. It is characterized by the formation of yellowish white, thin plaques standing out against the reddened mucosa of the cheeks, lips, tongue and bases of the gums, but not on the gums themselves.

Noma, an acute and fatal condition that begins on the cheeks and spreads

*Read before the Section on Mouth Hygiene and Preventive Dentistry at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 22, 1928.

rapidly, is also a disease of weakened and poorly nourished children.

Tuberculous lesions are uncommon in children. Syphilitic lesions are not uncommon, although the latter are characteristic and react quickly to proper treatment.

Actinomycosis most frequently starts in the cheek in children, instead of in the gums, as is the case with cattle. It is rarely met in these days of supervised dairying.

Herpes of the lips or of the mucosa (canker) is very common during childhood. It is usually attributed to faulty diet or to constipation. Elimination of the cause is the preferred treatment, although a careful application of 20 per cent silver nitrate or burnt alum is often prescribed.

Modern hygienic living has largely overcome scurvy with its attendant gingivitis. Mild cases of scurvy, in which gingivitis is the outstanding symptom pointing to a faulty diet, are by no means infrequent, however, even today.

There are many causes of gingivitis during childhood, and there is some credence given the opinion of certain modern European writers that a type of pyorrhea actually exists in early childhood. I have observed many cases of extensive serumal deposits with definite suppuration under the gums in children as young as 11 or 12 years.

Probably one of the most difficult pathologic conditions to cope with successfully is a true Vincent's infection. Whether it begins in the tonsillar region and spreads onto the posterior gums, or is limited to the gums, lips and cheeks, quick action is indicated whenever the symbiotic action of the fusiform bacillus and its accompanying spirochete is evidenced in the form of an ulcerative stomatitis.

Many treatments are proposed, varying from strict hygiene alone to radical procedures, most of which entail periods varying from many days to several weeks.

May I suggest a treatment that has proved successful in the treatment of many cases? The office treatment consists of the following:

First, scale carefully if necessary and flush thoroughly with 50 per cent hydrogen peroxid. Isolate one section of the mouth at a time with cotton rolls and apply carefully to the ulcerated areas a 20 per cent solution of silver nitrate. Leave the silver nitrate on the tissues until they begin to whiten. Then, cover the affected areas with a solution of equal parts of tincture of iodin and glycerin.

The office treatment should be repeated twice daily if possible, or at least daily for from three to five days, only the most severe areas being treated as healing progresses. In cases that have been neglected, the subcutaneous injection of sodium cacodylate is a splendid general treatment.

The home treatment should consist of thorough hourly rinsing of the mouth with 50 per cent hydrogen peroxid during the waking hours for at least one week. A mild cathartic is also indicated.

Infections that occur at the root ends of deciduous teeth, at the roots or at the apices of permanent teeth during childhood have not received the attention they deserve. Contrary to the general notion, this is the most jeopardizing condition that exists during early life. We have failed miserably as a profession in neglecting this type of pathologic condition. It is unquestionably the most important phase of our dental practice as related to general health.

The most recent information given out by the United States Government concerning the causes of death in children between the ages of 10 and 14 over a period of ten years, "Mortality Rates 1910-1920," is shown in the accompanying table.

DEATH RATE PER HUNDRED THOUSAND FOR CHILDREN FROM 10 TO 14

Organic heart disease	23.9
Pneumonia	19.7
Tuberculosis of lungs	17.1
Violent deaths	16.3
Diphtheria and croup	13.9
Tuberculosis not of lungs	8.8
Nephritis	7.2
Typhoid fever	5.2
Scarlet fever	5.1
Diabetes	4.9
Measles	1.4
Whoopingcough	0.4

It is interesting that heart disease heads the list and that it claims more lives than diphtheria, croup, typhoid fever, scarlet fever, measles and whoopingcough combined.

Further data reveal the fact that, whereas the diseases common to childhood have been gradually on the decrease for the past twenty years, heart disease during the same period has been increasing.

The New York Society for the Prevention of Heart Disease divides the responsibility for heart disease about equally between early contagious diseases and focal infections. The tonsils and teeth are the seat of most focal infections. The common deduction would be that the teeth are the source in 25 per cent of the cases. But we do not need exact statistics. Even allowing for discrepancies, the percentage is so startlingly large that we face a grave responsibility. What are we going to do about it?

The answer to most problems of similar proportions lies in furthering education, particularly in dental schools. We have made and shall always make unintentional mistakes, but in the light of our present knowledge, let us strive to do our professional share in making the lives of our children sweeter, safer, happier.

DISCUSSION

W. T. McFall, Macon, Ga.: To my knowledge, this is the first paper that has been presented before this section on the soft tissues or on any subject having to do with the examination of the child's mouth. Dentists all over this country have been filling teeth, pulling teeth, cleaning teeth, and that is about all. Recently, I have moved from the state where I have practiced most of my professional life, and since changing my location, I have run across more cases of stomatitis than I think had ever been in the town before. I am in the health department. There is a higher death rate from tuberculosis now than there was five years ago. But the difference is that the health officer is finding the cases, whereas they had not all been found heretofore. I have had seventeen cases of aphthous stomatitis since I have been in Macon, a little less than three months. Half of the cases diagnosed as aphthous stomatitis have been treated by simply painting the parts with iodin and three of the cases as treated became so bad that it was necessary to take the children to a hospital. A fibroid ankylosis developed, and it was necessary to use a general anesthetic in order to break up the ankylosis and reach the children's mouths. Dr. Rhobotham has given us some splendid treatments. There are others just as good. But the trouble is this: the general practitioner is failing to diagnose the condition. He is just jumping at conclusions. The treatment of Vincent's infection and the different forms of stomatitis is one of the most important things in children's work. I was glad to hear Dr. Rhobotham bring out the point about the number of heart lesions. So often men have said, "You are wrong about the necessity of taking out abscessed teeth." My remark always is that I would rather have a mutilated mouth than a mutilated heart.

THE DEVELOPMENT OF THE BIFURCATION OF MULTIROOTED TEETH

By BALINT ORBAN, M. D., and EMIL MUELLER, D.D.S., M. S., Chicago, Ill.

MUCH research work has been done on tooth development in general, but, so far, little consideration has been given the development of the bifurcation.

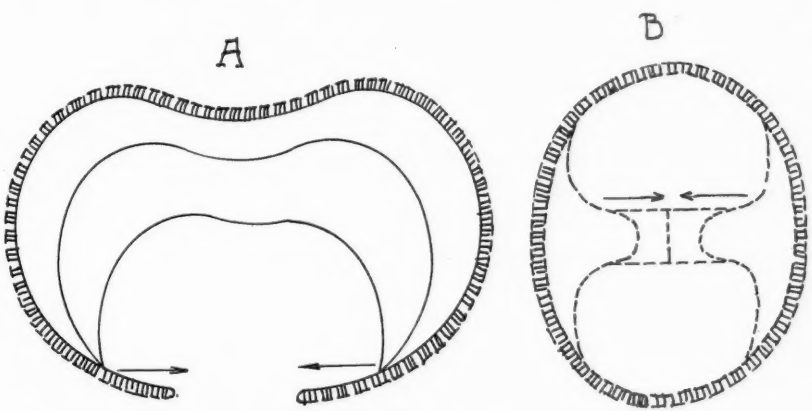


Fig. 1.—Diagram showing the origin and the development of the bifurcation of multirooted teeth. *A*, tooth-germ from the side. The hatched areas around the tooth germ indicate the enamel epithelium, the ends of which, marked by arrows, are Hertwig's epithelial sheath. *B*, the tooth germ viewed from the basal opening. The shaded area is Hertwig's epithelial sheath. The arrows indicate the direction in which the epithelial sheath is supposed to grow.

It is assumed that after the crown portion of the tooth develops, certain points of Hertwig's epithelial sheath commence horizontal growth toward the center of the pulp. This process is diagrammatically illustrated in Figure 1. *A* shows the crown portion of the tooth covered with the enamel epithelium. The apical end of the enamel epithelium pointing toward the center is Hertwig's epithelial sheath. The arrows indicate the direction in which the epithelium is thought to grow. *B* shows how these processes were to grow together to form the bifurcation when viewed from the bottom. Later in development, dentin is laid down inside the sheath, and, in this way, the outline of the bifurcation develops.

No accounts of investigations showing exactly the details of this process

have thus far been published. Weski and Contreras[1] attempted to explain bifurcation development upon the basis of a few histologic pictures. Their material as well as their methods was inadequate. Their diagrammatic drawings which they called reconstructions of the histologic specimens were only reconstructions of the authors' conceptions, and not reconstructions of the true specimens.

The high point of this newer observation is that the epithelium does not grow into the depth to form the dental lamina and tooth germs, but certain portions of the epithelium remain in relatively fixed positions, while the surrounding tissues grow. Measurements from extensive human material verify this observation.

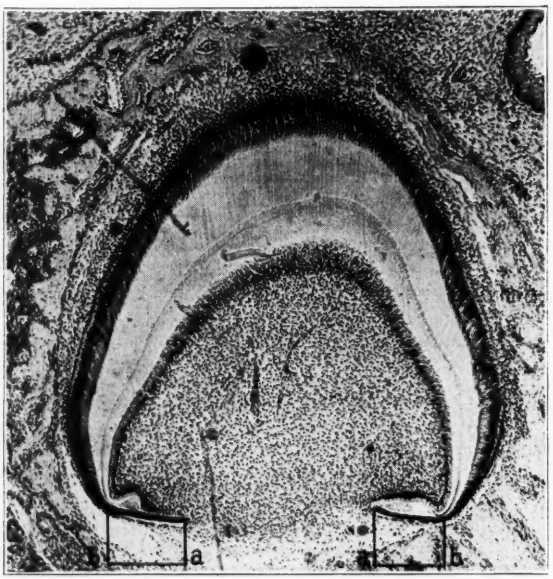


Fig. 2.—Section through a molar of a rat. *a*, the pulpal or central end of the epithelial sheath. *b*, peripheral end of the same where it joins the enamel epithelium. In the tracings, these points have been marked throughout the entire series.

Developmental problems cannot be solved with single specimens and the gaps filled in from the imagination.

Because of recent newer observations in tooth development,[2] we felt it necessary to conduct investigations covering this phase of the development.

While conducting these investigations, it was found that the development of the root does not proceed as it was formerly thought. The former view assumed that

1. Weski, O., and Contreras, R.: Befunde und Vorgänge im Interradikulärraume Mehrwurzeliger Zähne; Vierteljahrschr. f. Zahnheilk., 1924, Parts 2-3, p. 229.

2. Orban, Balint: Growth and Movement of Tooth Germs and Teeth, J. A. D. A. 15:1004 (June) 1928; Dental Histology and Embryology, Chicago: Rogers Printing Co., 1928.

Hertwig's epithelial sheath grew into the depth to precede the development of the root. The studies of one of us (B. O.) have shown this view to be incorrect. Hertwig's epithelial sheath during the entire development of the tooth marks the relatively fixed point. The whole growth of the tooth takes place from this point peripherally. These observations are incompatible with the former theoretical conception of bifurcation development. This incompatibility prompted the present investigation.

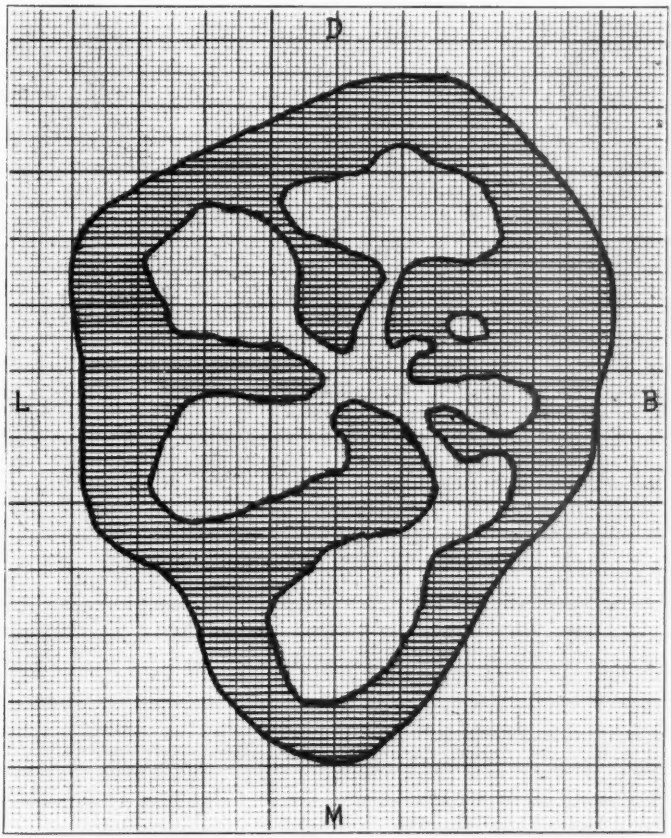


Fig 3.—The outline of Hertwig's epithelial sheath of the upper first molar of a rat 8 days old. The inner heavy line corresponds to *a* in Figure 2; the outer heavy line, to *b*. Each horizontal line between the two heavy lines represents the epithelial sheath. *D* indicates the direction distally; *M*, mesially; *L*, lingually, and *B*, buccally.

The study of bifurcation development on human material is almost impossible. Embryos over 200 mm. in length are

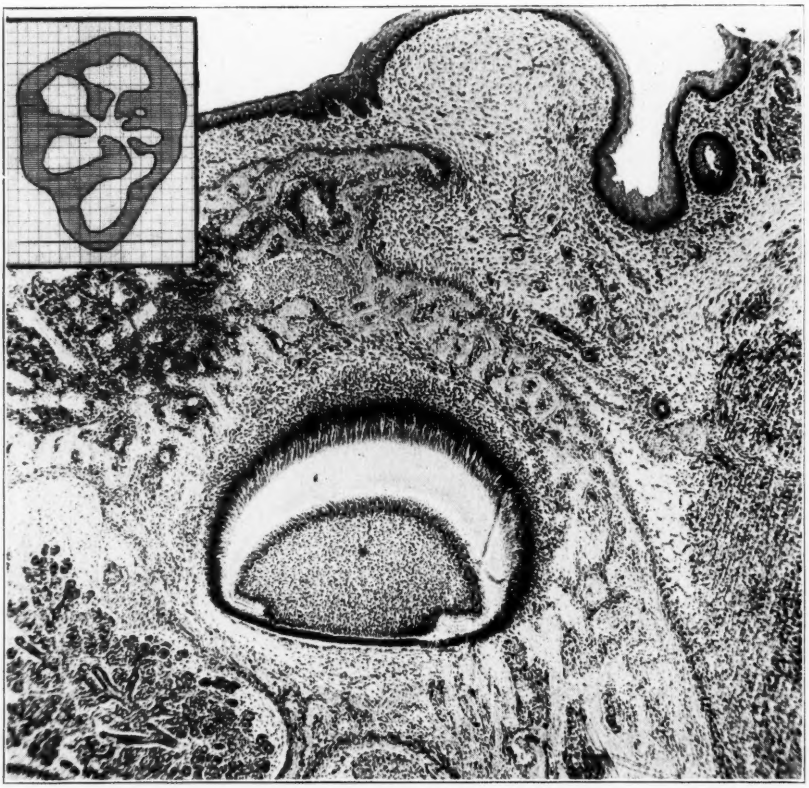


Fig. 4.—Tooth germ of the upper first molar of a rat 8 days old. The section was cut mesially of the basal opening, and so the epithelial sheath is continuous.

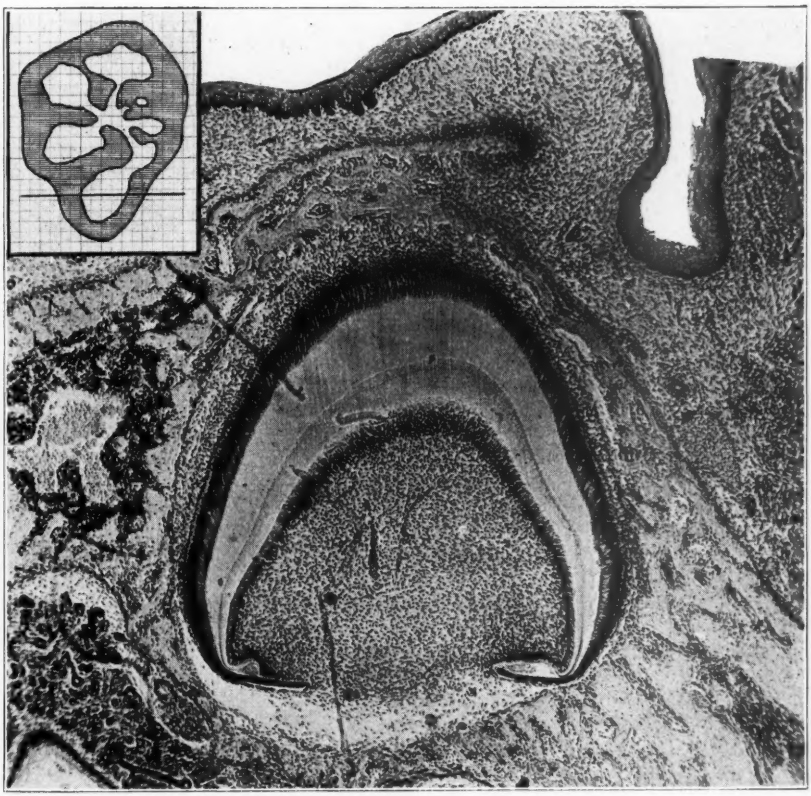


Fig. 5.—Tooth germ of the upper first molar of a rat 8 days old, the section being made a little more distally from the location of that in Figure 4, corresponding to the horizontal line in the corner diagram. The epithelial sheath extends equally on both sides.

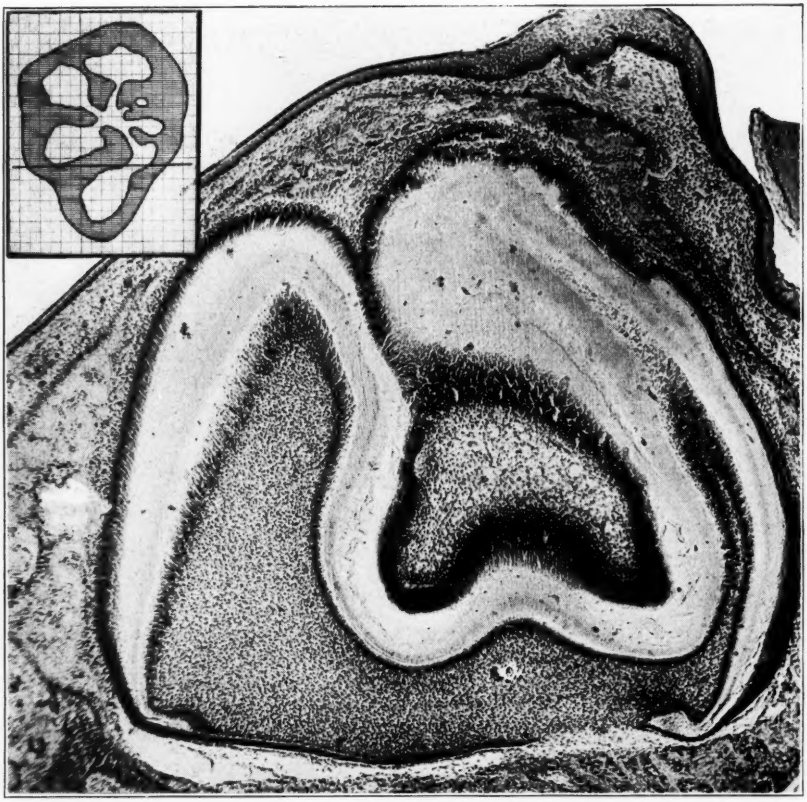


Fig. 6.—Tooth germ of the upper first molar of a rat 8 days old. The section was made still further distally than in Figure 5. A comparison with the corner diagram explains the lateral position of the basal opening and the greater length of the epithelial sheath on one side.

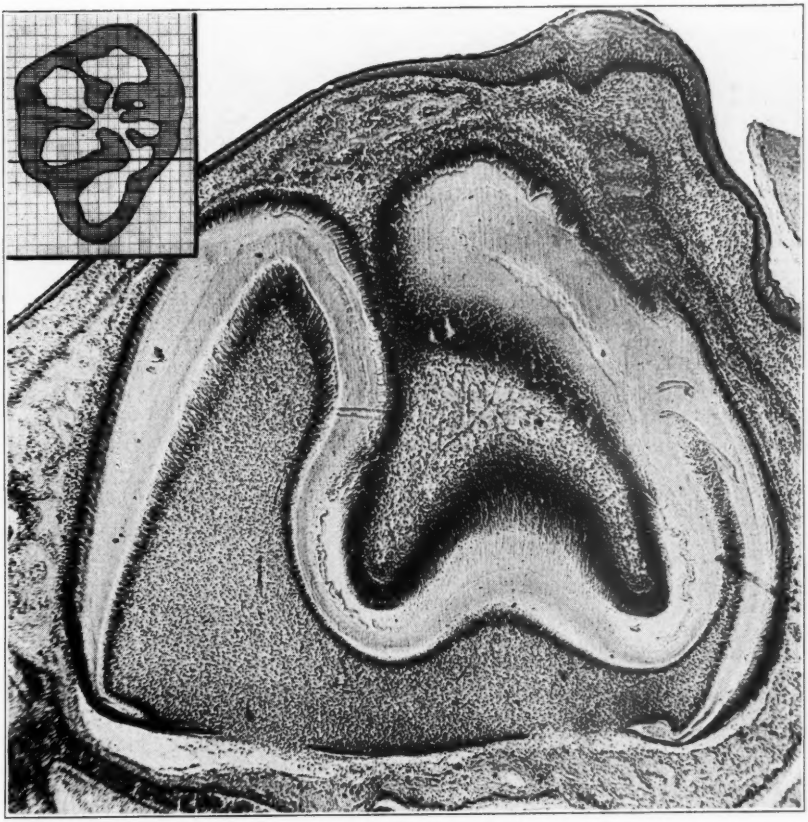


Fig. 7.—Tooth germ of the upper first molar of a rat 8 days old, the section being made through the tooth germ corresponding to the horizontal line in the diagram. Two basal openings are present, separated from each other by a long epithelial island.

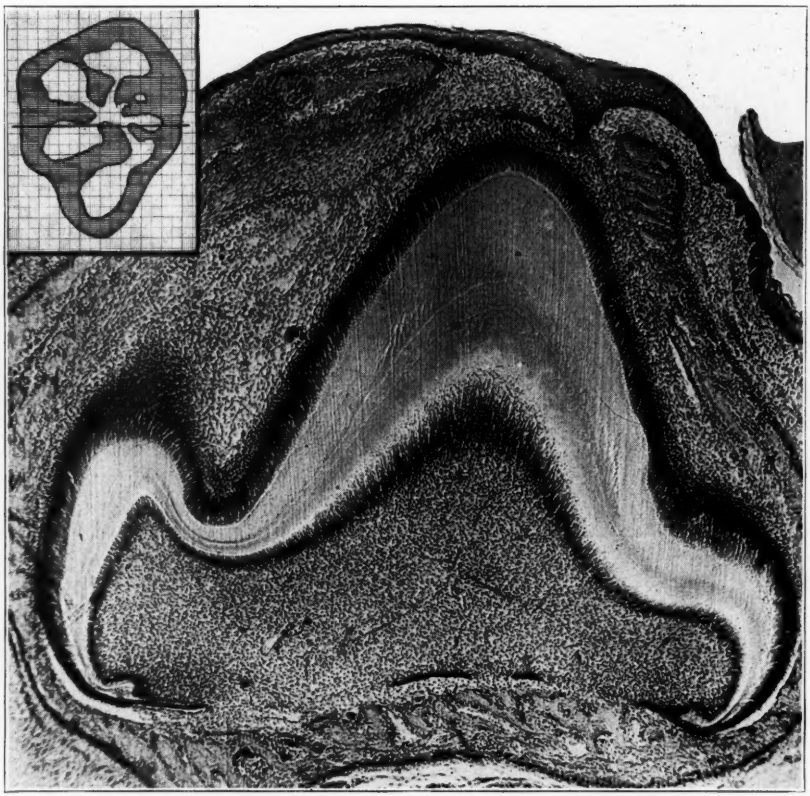


Fig. 8.—Tooth germ of the upper first molar of a rat 8 days old. Three openings lead to the pulp, and two epithelial islands are to be seen. Only the serial reconstruction as given in the diagram can explain this occurrence.

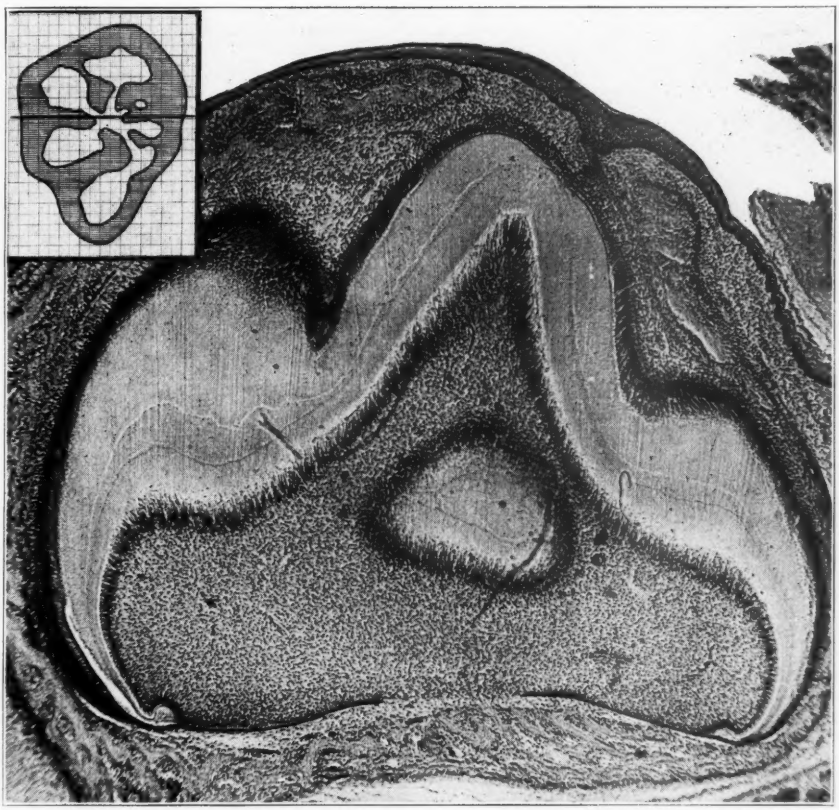


Fig. 9.—Tooth germ of the upper first molar of a rat 8 days old. The section is from near the center of the tooth germ. There is only one opening in the center, and two long Hertwig's epithelial sheaths.

necessary for this work, and these are very difficult to obtain in series of age. We therefore decided to conduct our investigations on material from rats. We assumed that the biologic processes that take place during development are

saw that the bifurcation development was already completed.

After thoroughly studying the complete series of sessions, we concluded that some definite form of reconstruction was absolutely essential on account of the ex-

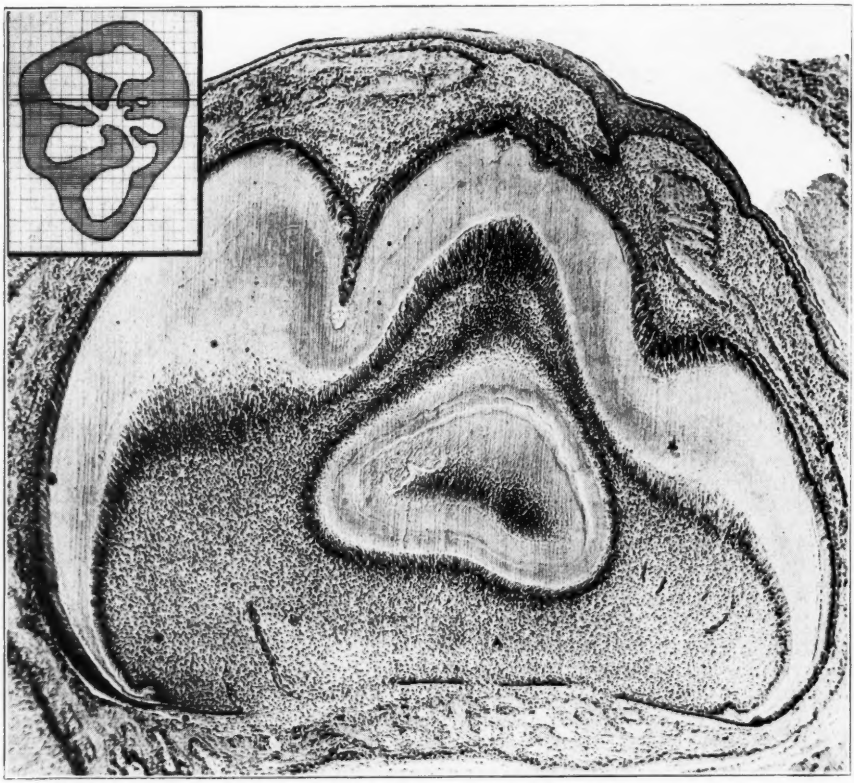


Fig. 10.—Tooth germ of the upper first molar of a rat 8 days old, the section being made further distally than in Figure 9. Three openings again separated by epithelial islands lead to the pulp.

similar to those in the human being. For this work, we obtained complete serial sections from rat jaws, the rats ranging in age from a few days before birth to twenty days after birth. At this age, we

treme complexity of the material. Only through reconstruction can the exact development be visualized. Two means of reconstruction were available: (1) the construction of models and (2) the

making of serial microscopic drawings. The latter seemed better suited for our purpose. With the presentation of Figure 2, a description of our method will be given. This is a photomicrograph from a section through a molar of a rat

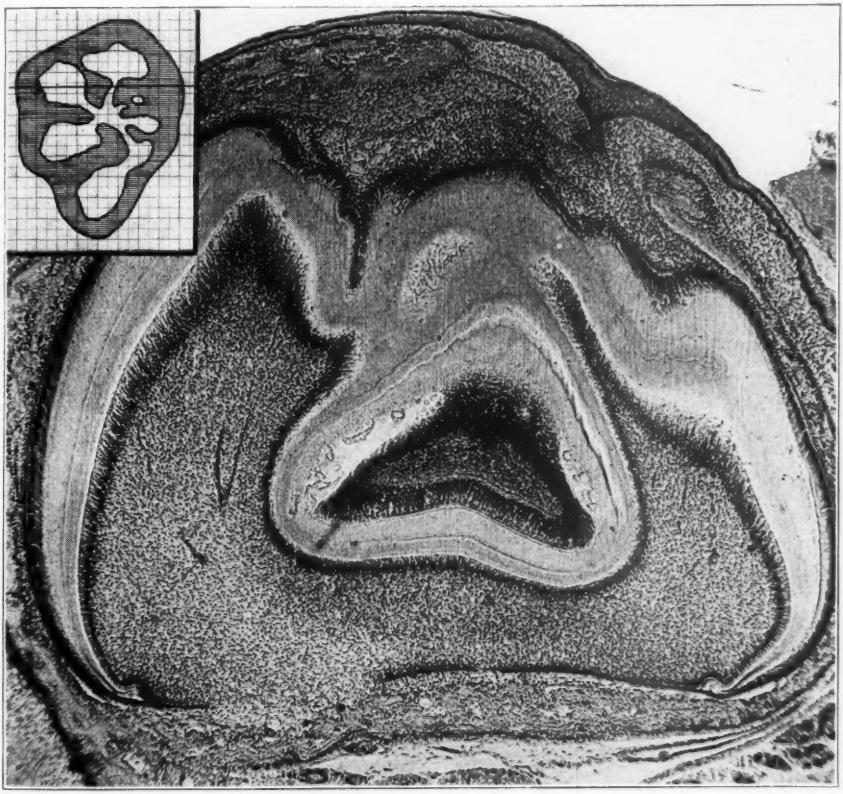


Fig. 11.—Tooth germ of the upper first molar of a rat 8 days old. The changed picture corresponds to the change in the shape of Hertwig's epithelial sheath. One small and one large opening indicate the basal opening of the tooth germ.

8 days old. The serial sections were projected onto millimeter-ruled paper with a micro-projecting apparatus. Hertwig's epithelial sheath was traced from the pulpal or central end *a* to the peripheral end where it joined the enamel epithelium *b*. We repeated this with each section of the series. The single tracings were spaced 1 mm. apart because of the thickness of our specimens, 20 microns. We enlarged the specimens fifty times. The series of lines were connected at both ends, and, in this way, the outline of the entrance to the pulp, i. e., the basal opening of the tooth germ as well as the exact shape of the entire

Hertwig's epithelial sheath, was obtained. In order to ascertain the true anatomic shape of our tracings, it was necessary for us to observe the topographic relationship of the tooth to other organs.

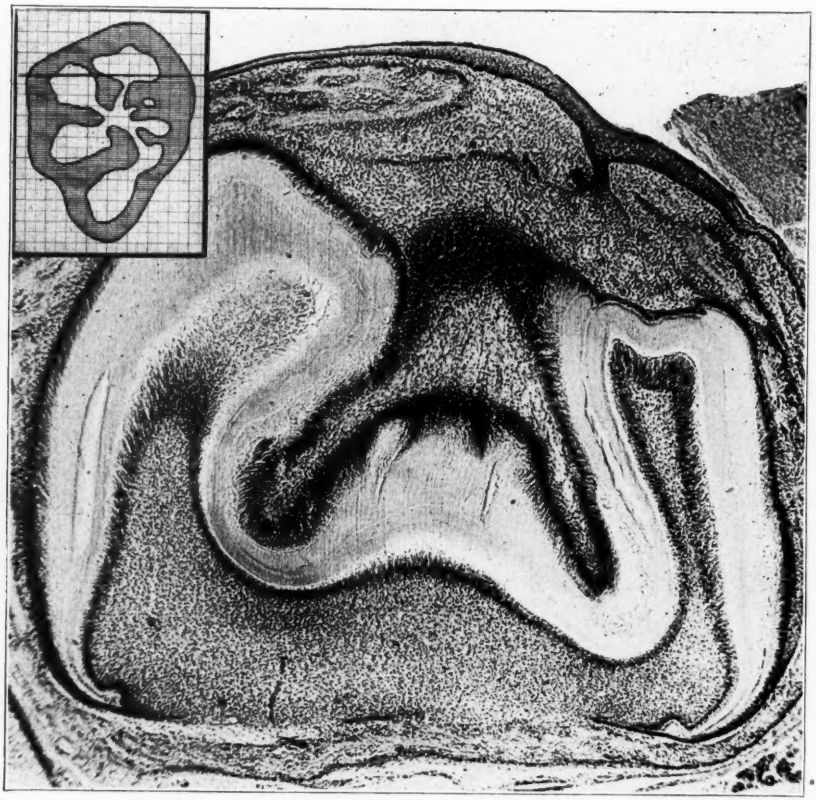


Fig. 12.—Tooth germ of the upper first molar of a rat 8 days old. The section is through the distal third of the tooth germ. Two root openings explain the two large spaces separated from each other by an epithelial island. This epithelial island, if compared with the corner diagram, is manifest as a cross-section of an epithelial peninsula.

We desire to call attention to the fact that it was sometimes difficult to determine exactly where to set the border line between Hertwig's epithelial sheath and the enamel organ, so that the outer heavy line has sometimes been set arbitrarily. We would also stress the fact that we were not particularly concerned with the number, size or distribution of the root canals, but were primarily concerned with the order of development of the bifurcation.

The outline of Hertwig's epithelial sheath and the progress of the develop-

ment of the bifurcation of the upper first molar of a rat 8 days old is shown in Figure 3. The inner heavy line outlining the irregular opening corresponds to *a* in Figure 2; the outer heavy line corresponds to *b* in Figure 2. Each horizontal line between the two heavy lines represents epithelium; i. e., Hertwig's epithelial sheath. The space inside of the inner heavy line is the entrance to the coronal pulp; that is, what we call the basal opening of the tooth. The lower part of the picture is the mesial side; the upper, the distal; the right, the buccal, and the left, the lingual side. To show in more detail just how we obtained the basal openings, we will show interrupted series of pictures from the specimens from which Figure 3 was constructed. In the left upper corner of each photomicrograph, we present a reduced photograph of Figure 3. The

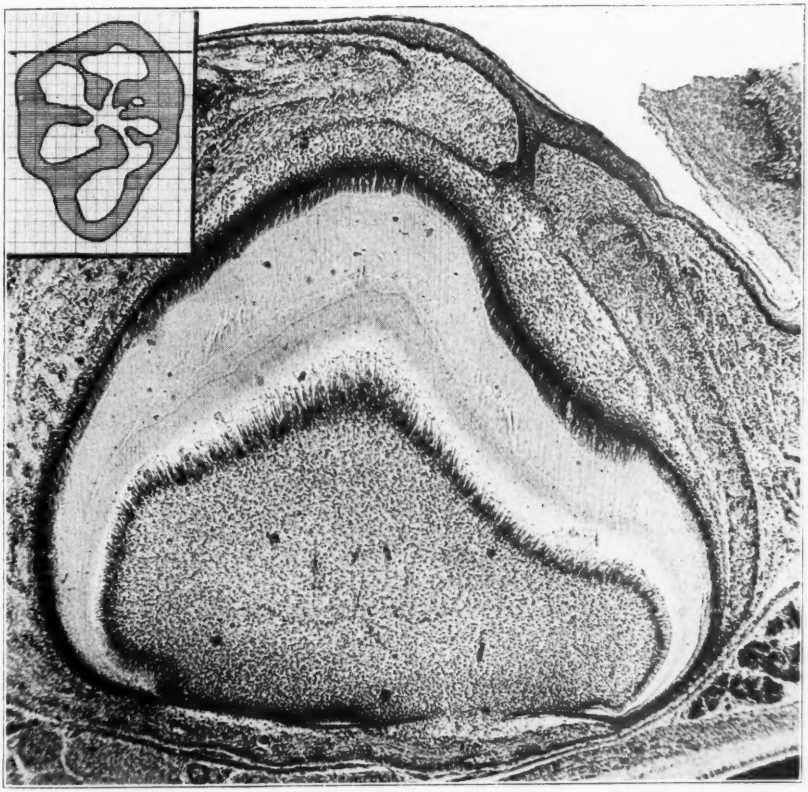


Fig. 13.—Tooth germ of the upper first molar of a rat 8 days old. This section is from near the end of the basal opening. The single opening is located buccally. This explains the longer lingual epithelial sheath.

horizontal heavy line in this picture indicates the location of the section in the series from which the corresponding photograph was taken. The section shown in Figure 4 was cut through the tooth germ at the mesial side at a point

diagram. We see the epithelial sheath of the tooth extending toward the center about equally on both sides. This position of Hertwig's epithelial sheath at right angles to the walls of the tooth is almost the typical position of the

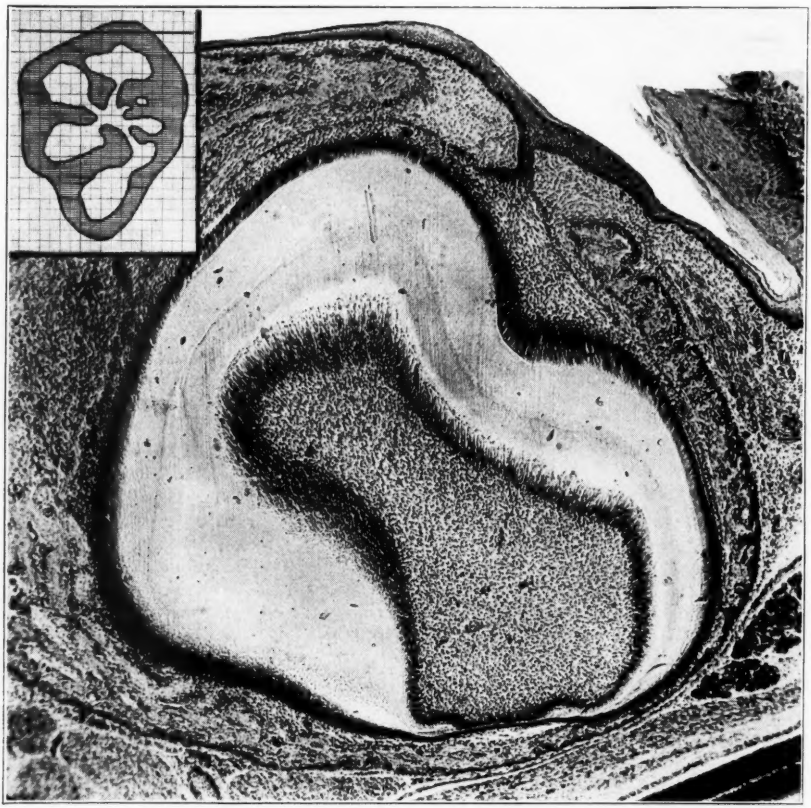


Fig. 14.—Tooth germ of the upper first molar of a rat 8 days old, the section being distad from the basal opening. The epithelial sheath is again continuous as it is in Figure 4.

where Hertwig's epithelial sheath was continuous. Figure 5 was taken from a section a little more distally from the location of that in Figure 4, corresponding to the horizontal heavy line of the

sheath in all stages of development. Figure 6 was taken still more distally. On one side, Hertwig's epithelial sheath is much longer than on the other, and the basal opening is correspondingly well

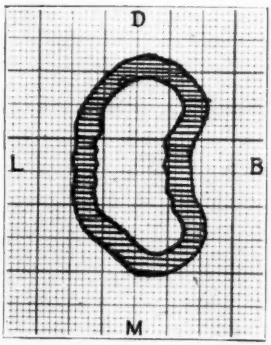


Fig. 15.—Basal opening of the upper first molar of a rat 5 days before birth.

terrupted, and we now have on both sides of the tooth short epithelial sheaths. About midway between the two, there is an elongated island and two openings leading to the pulp. Only complete serial sections afford the explanation for this occurrence. The epithelial island is only a cross-section of a peninsula, a projection of Hertwig's epithelial sheath, as can readily be seen from tracings of all sections of the series. The picture appears to be more complicated in Figure 8. Here, we have two short islands between the outer sheaths. In reconstruction, the longer island is shown to be

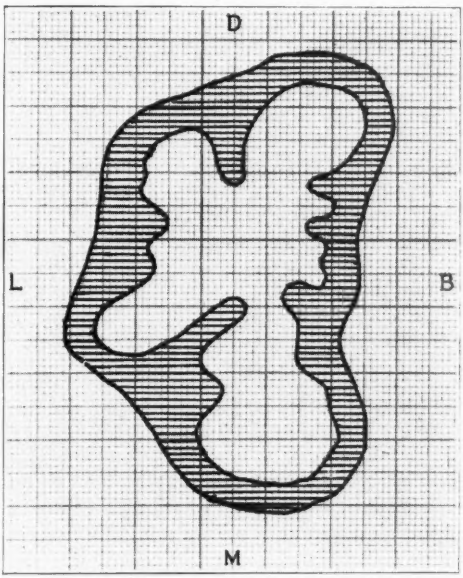


Fig. 16.—Tracing of the basal opening of the upper first molar of a rat 1 day old.

toward one side. The study of the diagram serves to explain this. The section of Figure 7 was obtained further distally than the section of Figure 6. The former long lingual sheath is now in- the end of the peninsula extending from the mesiolingual side. The shorter is the end of another peninsula projecting from the buccal side toward the center. The left opening of the three is formed

by one of the lingua roots. The small opening in the center is a space between two epithelial projections. The space on the right side, as will be seen later, marks the opening of a separate root. Figure 9 is a section obtained from near the center of the tooth germ. There is only one opening in the center and two long Hertwig's epithelial sheaths. For further explanation, we refer to the diagram. Figure 10 shows again a changed picture. We see three openings and two epithelial islands. The two epithelial islands at the center are the cross-sections of projections of epithelium different from those referred to in Figure 8. These projections in Figure 10 are epithelial extensions from the buccal and distal sides of the tooth germ. In Figure 11, the small opening on the buccal side has disappeared, and only a small opening in the center and a larger opening on the lingual side remain. Figure 12 is a section through the distal third of the tooth germ. Two root openings explain the two large spaces separated from each other by an epithelial island, a cross-section of the distal peninsula. Figure 13 is a section more distally than Figure 12. One of the openings has disappeared and only one opening is located more buccally. This explains the longer lingual epithelial sheath. Figure 14 is a section distally from the last root opening, and Hertwig's epithelial sheath is again continuous as in Figure 4.

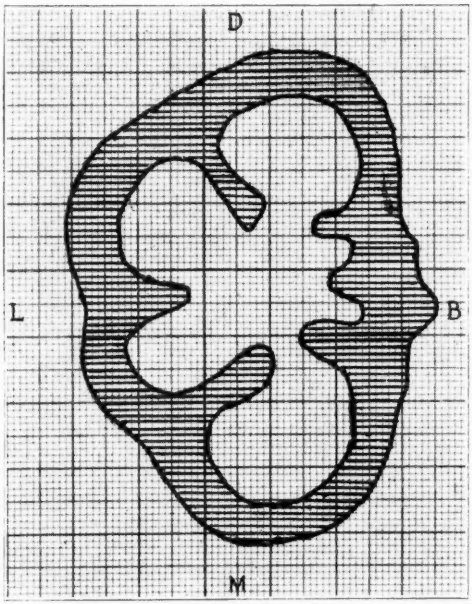


Fig. 17.—Tracing of the basal opening of the upper first molar of a rat 4 days old.

With this presentation, it should be evident how interpretations from single

sections can lead us into error. Uninterrupted series and uniformly thick sections are absolutely essential for this kind of work.

In the following figures, we present our tracings of upper and lower first molars from rats of different ages. In all figures, the lower portions of the pictures are the mesial sides (*M*); the upper, the distal (*D*); the right, the buccal (*B*), and the left, the lingual sides (*L*). Figures 15 to 20 are tracings from upper first molars. Figure 15 shows a tracing of a basal opening of a molar from a rat five days before birth. The opening is kidney-like in shape, with

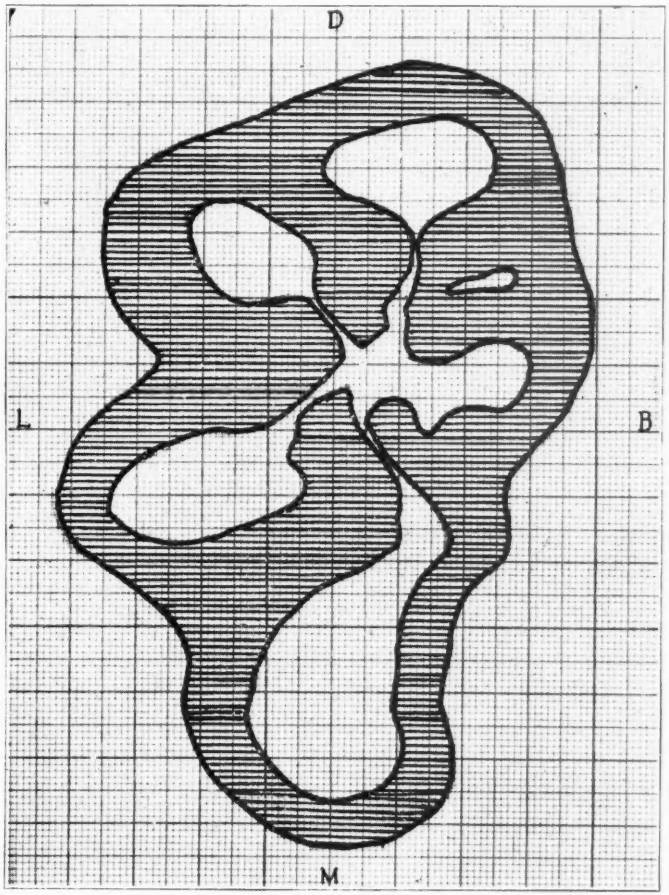


Fig. 18.—Tracing of the basal opening of the upper first molar of a rat 11 days old.

the long axis mesiodistally. The buccal side is somewhat concave, the lingual, convex. In Figure 16, we observe the basal opening of a molar from a rat 1 day old. Here, already we find a radical difference from Figure 15; which calls for an analysis. The gross shape is approximately the same as in the rat five days before birth. There is, however, a marked difference in size. The chief change in comparison with the former stage has taken place in the outline of the basal opening. In Figure 15, we note that the outline of the basal opening (*a*, Fig. 2) is parallel to the outer line of Hertwig's epithelial sheath (*b*, Fig. 2). That means that Hertwig's epithelial sheath is of the

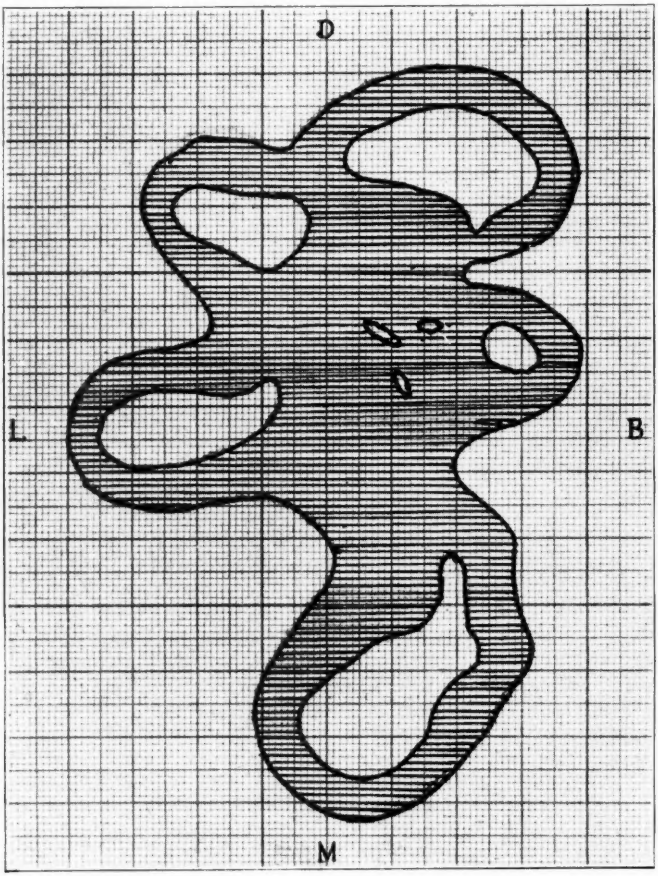


Fig. 19.—Tracing of the basal opening of the upper first molar of a rat 15 days old.

same length all around the basal opening. In Figure 16, finger-like projections point toward the center of the opening. We can, at this early stage, detect the location of the later roots. This is a most remarkable fact, for we see that about this demarcation, is not correct. We see, in Figure 16, the basal opening of a molar of a rat 1 day old. This already shows a definite shaping toward the future root outline. In this stage of tooth development, no dentin has yet

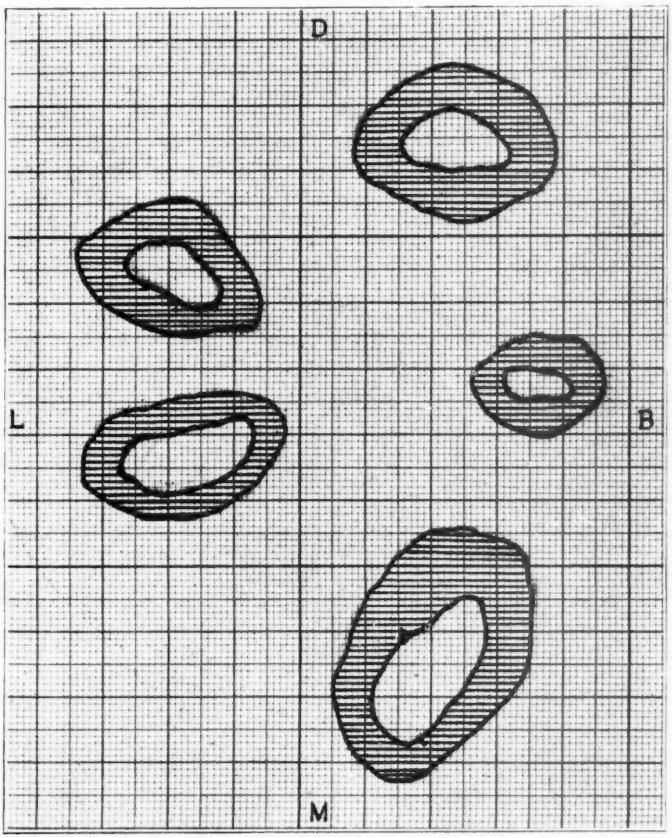


Fig. 20.—Tracing of the basal opening of the upper first molar of a rat 19 days old.

the former view, i. e., that the demarcation for the roots commences after the crown has fully developed and that Hertwig's epithelial sheath grows horizontally toward the center to bring been deposited. During this stage, we can hardly speak of the finished development of the crown. The question arises whether the irregular outline of the basal opening is due to an inward growth of

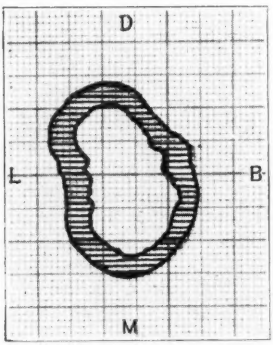


Fig. 21.—Tracing of the basal opening of the lower first molar of a rat five days before birth.

of development, the formation of the irregular outline is due to an eccentric enlargement of the whole basal opening peripherally rather than to an active inward growth of certain portions of the epithelium. The finger-like projections of Hertwig's epithelial sheath are peninsulas of epithelium which remained fixed while portions of the epithelium pulled away to make room for future roots. In a section from a rat 4 days old (Fig. 17), the development has further progressed. The outline of four of the roots is definitely to be seen. On the buccal side, irregularities appear. In this stage, also, the development has been due

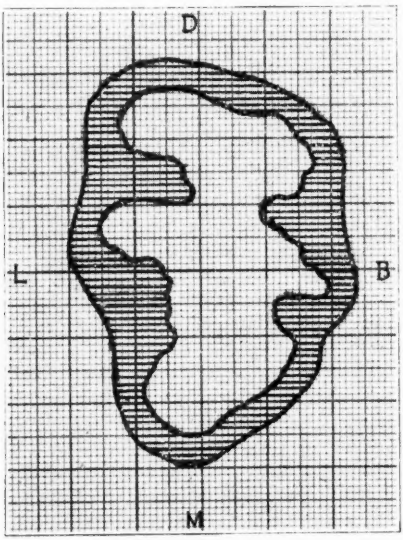


Fig. 22.—Tracing of the basal opening of the lower first molar of a rat 1 day old.

certain points of Hertwig's epithelial sheath, as it was formerly believed, or whether some other order of development takes place. From our serial tracings, we must state that, up to this stage largely to expansion of the organ. A slight thickening of the epithelial projections indicates a certain activity in this region. Dentin development has just begun in this stage. The next stage, a

section from a rat 8 days old, has already been seen in Figure 3. The development of the bifurcation has advanced considerably, and the outline of the different roots is becoming more distinct. Now the epithelial projections have not only thickened but also show definite inward growth. Through further thickening of the ends of the finger-like projections, the division of the roots will be brought about. The larger spaces, which will be the future roots, are still connected with each other through narrow channels. In a rat 11 days old (Fig. 18), the channels connecting the larger spaces have become very much more constricted. The irregularity on the buccal side, to which we have called attention in Figure 17, has now developed into an area which will form a root. In a rat 15 days old (Fig. 19), the channels formerly connecting the roots have largely disappeared, leaving only a few small openings[3] to indicate their former location. The direction of the small openings and the shapes of the root openings point toward the lines of fusion of the epithelium. Figure 20, from a rat 19 days old, shows progression of the root development to the

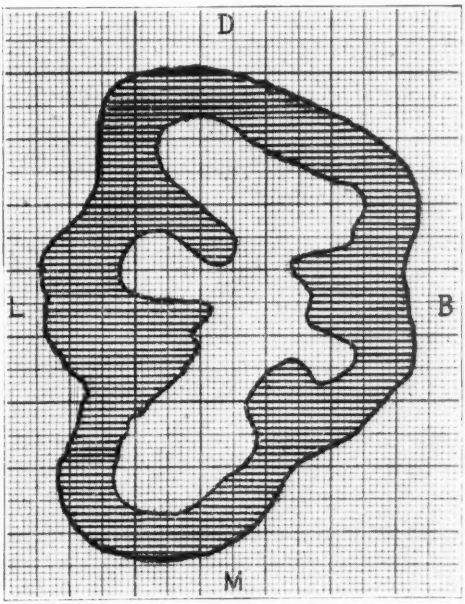


Fig. 23.—Tracing of the basal opening of the lower first molar of a rat 4 days old.

3. W. H. F. Addison and J. L. T. Appleton consider these small openings the result of faulty fusion of Hertwig's epithelial sheath. (Proceedings of the Sixth Annual Meeting of the International Association for Dental Research, J. Dent. Res., No. 3, p. 403, [June] 1928.)

point where the roots have become separated from each other.

Figures 21 to 25 are tracings from lower first molars from rats ranging in age from five days before birth to eleven days after birth. The same order of development to the upper molar from a rat 15 days old (Fig. 19).

This particular subject does not require any further description. The pictures and tracings tell their own story. It is true that there are many more dif-

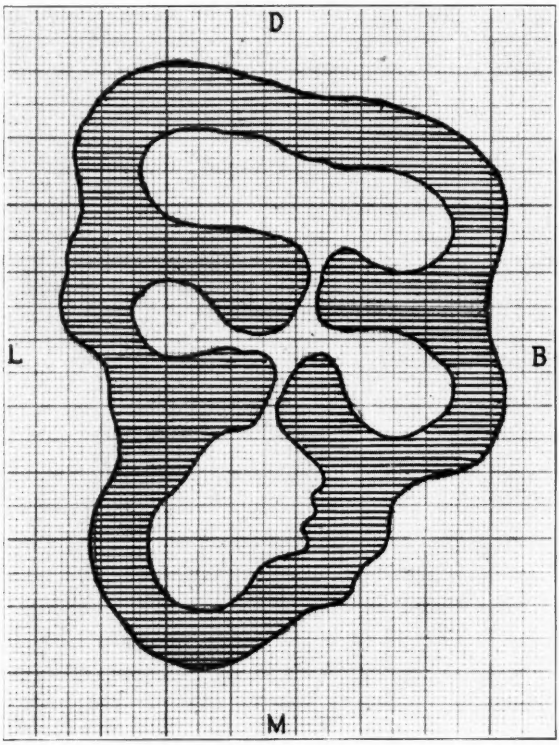


Fig. 24.—Tracing of the basal opening of the lower first molar of a rat 8 days old.

velopment can be followed through this series. The chief difference between this and the upper series is that the development of the lower teeth proceeds, apparently, more rapidly than that of the upper. Figure 25, obtained from a rat 11 days old corresponds in development to the upper molar from a rat 15 days old (Fig. 19).

ferent points for discussion into which we did not enter. We had selected for ourselves a certain definite problem and this we have covered.

Our conclusions are:

The bifurcation is determined long before the crown development is com-

pleted. The roots are first outlined by eccentric peripheral enlargement of the basal opening of the tooth germ. In this eccentric growth, certain portions of Hertwig's epithelial sheath remain relatively fixed, though later these projections enlarge and unite to form the bifurcation which demarcates the roots.

The horizontal position of Hertwig's epithelial sheath, composed of a double layer of cells, and the determination of the later roots in the very early stages of development preclude any possible epithelial downward growth.

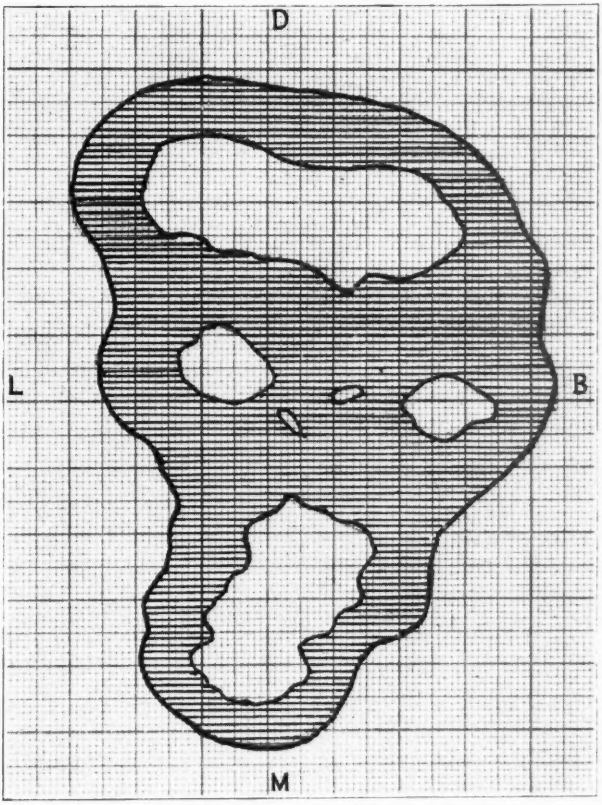


Fig. 25.—Tracing of the basal opening of the lower first molar of a rat 11 days old.

The observation that Hertwig's epithelial sheath is a fixed point from which the tooth germs grow peripherally is confirmed.

THE PSYCHOLOGY OF HANDLING THE CHILD PATIENT*

By RAY W. NOLAND, D.D.S., Des Moines, Iowa

FOR the last twenty years, mothers have been anxious to learn all they can about health. They have studied hygiene and dietetics, in the hope of providing their children with the environment which would insure that they would grow up with sound teeth, well developed muscles and healthy digestions. Now there is a new phase beginning. It is being realized that just as a knowledge of hygiene is the basis of health, so in the study and application of psychology lies the great hope of increasing human happiness.

It is only within the last few years that psychology has been thought important in the training of children, and it is making a real appeal to parents and teachers. They are endeavoring to understand children from a psychologic point of view, and are using tact in managing them.

The orthodontist, who works with all types of children, should appreciate and understand something of child psychology, if he is to be successful in handling the child with the least amount of excitement to the patient and annoyance to himself and the parents.

There are only three fundamental emotions present at birth, which are: fear, rage and love. Of these three, the fear emotion is the one which we have to consider most in handling child patients.

It is true that many children dread or fear dental treatment, and we should overcome this emotion in the child patient by using indirect suggestion. Psychologists tell us that fear is the most common emotion which human beings experience, and that most fears are produced by some experience through which the individual has had to pass in early life. Some children are afraid of anything new or strange, but they soon become accustomed to it if they are allowed to do so gradually. It is a mistaken notion that a child should be pushed into a situation where he is afraid in an effort to "train him." The fears based on a real experience can be overcome by gradually presenting a more pleasant view of the same situation, or by appealing to the child's courage to face his fears bravely.

All children are suggestible, and if they develop a fear for any particular thing, as, for instance, thunder and lightning, it can be overcome only with the help of intelligent suggestion from their older associates.

Once the attitude of fear is established, it accumulates and is strengthened by each new opportunity offered. Emotions tend to accumulate, and it is true that each of us is carrying around in his inner life attitudes which developed back

*Read before the Section on Orthodontia and Periodontia at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 22, 1928.

in early life and have gone on accumulating throughout the years.

"Fear," as Darwin emphasizes, "is a devastating and destructive emotion." And in view of the fact that so many people suffer from neurosis, which may be a result of the fear emotion, we should do everything that we can to protect the child against fear. Suggestions should be made which appeal to his courage and manliness, and above all the dentist should be calm and matter-of-fact in his own attitude. Even a small baby will react to emotions shown by adults.

With some types of children, it is necessary to explain the work as much as time will permit. In other cases, we can keep the child's mind from fear by asking about his school activities. Have him tell about his playthings or the pets that he has at home. It is usually time well spent to allow the child to talk, especially the first few visits, as children, like adults, enjoy talking about their own activities. Children will stand pain if you have won their confidence, and they understand that they are to be helped by the operation. I find it is always best to start, particularly with a very small child, by doing just a little painless work. In the extremely nervous child, it is a very good plan to have him visit the office two or three times before starting to make the appliances.

It is also advisable to be truthful to patients. If the child has been told that the dentist will not hurt him, and it then becomes necessary that something be done that will hurt, the unexpected pain may cause a fear which throws the child into a panic, at the sight of a dentist, his office, his instruments, or some other elements of the situation. Such a reaction may result in the operator's being powerless to help the child. This reaction can usually be avoided by telling the child that the work may hurt some, but emphasizing how much it will improve the efficiency and appearance of his teeth. Fortunately, the child patient, properly handled, can usually be kept in good spirits, as the general state of mind of the healthy, normal child is a well-defined feeling of happiness. The child is glad, cheerful, delighted, boisterous and noisy according to the circumstances. Bad temper is usually temporary and vanishes quickly.

Happiness is the normal state of mind of children, but this optimistic condition may be darkened by sentiment or dislike, and it is our duty to keep our patients happy as this is the secret of success in children's dentistry.

Children form a habit very quickly, and we should strive to have the child form the habit of thinking pleasantly of the dental office. Many times, the importance of forming right habits in early life is minimized or overlooked altogether. The health, happiness and efficiency of the adult man and woman depend to a very large extent on the type of habits that they acquire from their early environment. One not only develops habits of acting but of thinking and feeling in certain ways. All these tendencies are the outgrowth of training and experiences; they are not inherited.

Modern psychology tells us that to build a habit one must not only practice it, but must also feel that something has been accomplished. If an individual practices something with continued failure and annoyance, he finds himself less inclined to do this particular thing which annoys him. If this continues long enough, he develops an aversion. Continued satisfaction will build a positive habit; continued annoyance will build an aversion.

Therefore, it is very important that the child leave the office in an agreeable state of mind, as his last impression of the office is the one that he will remember. After we have completed our treatment, and are ready to dismiss the patient, some time spent by the dentist or assistant in convincing the child that he has accomplished something toward the completion of his case will satisfy the patient, and help him remember his visit to the dental office as a pleasant one.

Let us picture a few types of patients that we all have in our practice.

A girl, aged 8, who is brought to the office by her mother, comes into the operating room showing no evidence of fear or excitement. This patient talks freely; she may ask a number of questions, and may want different things explained. She wears intermaxillary ligatures if necessary, follows instructions in caring for her appliances and keeps her teeth nicely cleaned. The mother in this case stays in the reception room without being requested to do so. The home environment has helped to make this girl a good patient.

Another girl, aged 8, comes to the office accompanied by her mother. This girl appears frightened and wants her mother to be with her in the operating room. She does not talk and ask questions. The mother carries on the conversation and answers all questions directed to the patient. Possibly, the best way to handle a case of this type, is to suggest that the mother stay in the reception room. When the mother insists on being with her child, she can sometimes be tactfully handled by placing a chair, and asking her to be seated, and at the same time giving her a magazine to read, so that she will understand she is not needed to manage the child. As long as the mother stays in the operating room, the child will look to her for sympathy, and it will be difficult to keep the child's undivided attention. This case will require tact, first, in winning the child's confidence and helping her to feel at ease; secondly, in persuading the mother to allow the operator and assistant to take charge of the patient during the treatment.

A boy, aged 12, is sent to the office to have his teeth regulated. This boy gives no trouble in the office, but as the treatment progresses, he loosens the bands with sticky candy and comes in with missing finger springs. He does not know that they are missing, or they dropped off while he was attending a picture show. It is quite evident that his teeth do not respond to intermaxillary ligatures as they should, and yet he declares that he wears his rubbers as directed. To get results for this boy will require more than the necessary appliances properly adjusted. It would be well to have a talk with the boy; show him the casts, explain again the importance of wearing intermaxillary ligatures, and impress on him the extra work required when he loosens a band or breaks a finger spring. It may be necessary to call the parents to the office and explain to them that the case is not progressing as it should, and ask them to remind the boy not to play with the appliances, be careful about the candy he eats and check up on the rubber ligatures. Again, it will require tact not to offend the parents and at the same time to stimulate them to give their best cooperation.

Another type is the restless child who may have some nerve disturbance. It seems impossible for this patient to hold still, regardless of how hard he may try. Usually, the best way to handle the patient is to ignore his jerking and twisting. In an article on child man-

agement, the statement is made that it is as useless to request a "fidgety" child, to sit still as it is to ask him not to develop a rash and temperature when he is suffering from the measles.

To be successful in handling the different types of patients, it is most important that the operator keep himself in the right state of mind and conserve his energy by not allowing himself to become irritated. The best way to meet annoyances, irritations and petty difficulties is to ignore them, as any slight vexation encountered early in the morning will have its effect on one all the rest of the day. A splendid article, by Orrin Crooker, "The Office Economist," says:

> The only sure way to keep oneself feeling good inside, all day long and every day, is to cultivate the knack of living, as it were, on a higher plane of consciousness. One may best vision this, perhaps, as living on a hillcrest from whence one may enjoy a wider vision, a bluer sky, better and purer air. To keep oneself on this higher level in life is to see vexations and annoyances as part of a lower level, a level with which one's contact is only incidental to the real business of life.
>
> Resolve before you retire at night that you will not permit yourself to become irritated on the morrow. Tell yourself that you are going to live the whole day through on the higher level—in that house where you may enjoy so fine a view, such wonderful air, such bright sunshine.
>
> Start tomorrow right—by seeing something good in life about you. Go up the hill, so to speak, to that house on the hillcrest and take possession even before breakfast. Fill your lungs with the fine air on the height. Rejoice that you are so fortunate as to be able to spend the day in so splendid an environment.
>
> Get into your work while still under this uplift. Remember, as the day wears along, to speak the kindly word, the bit of praise. Think a good thought for those about you. All these may well be expected from one who lives in a house on a hilltop.
>
> Such things, too, help to keep one feeling good inside. Always, in giving pleasure to others, one finds some for oneself.
>
> There will be no sense of fatigue as your day comes to a close. The fast sinking sun will bring no thought of "another day gone to smash—and I with it."
>
> Rather, as you view the tired faces of the countless weary ones who share the homeward evening rush, you will find yourself wondering how many of them (or how few) enjoy anything like so good a feeling inside as belongs to you. And how you would like to tell some of them about the wonderful, though imaginary house, on the hillcrest, where you have spent the day.

Just as parents and teachers are studying psychology, in order to understand children, so should the orthodontist endeavor to comprehend the child patient from a psychologic point of view. There is no set rule for handling all types of patients. Every case is individual, and some study and effort are essential, if we are to be successful in (1) diverting the child's mind from fear by indirect suggestions; (2) keeping the patient happy, and (3) making the patient feel that something has been accomplished with each treatment. Finally, we should not loose sight of the fact that the operator should keep himself in the right state of mind, in order to have harmony between himself, the patient and the parents.

DISCUSSION

Max E. P. Ernst, St. Paul, Minn.: The problems involved in the management of the child must be met in different ways, depending on the child and also on the operator. The end which is sought is the same in most cases, namely, the gaining of the child's confidence in order that the necessary treatment may be performed in the best possible manner and in the least time consistent with the conditions at hand. It is, of course, impossible to lay down arbitrary rules for the different types of children, but years of contact with children in an orthodontic practice teaches the operator how best to manage the individual child. Dr. Noland says that during the last twenty years mothers have studied hygiene and dietetics in the hope of

providing their children with the environment which will insure them well developed bodies, sound teeth and the best possible health. How successful the study along these lines has been is clearly evidenced by the results. It is now common knowledge that proper nourishment, sunlight and fresh air are vital factors in the eradication of rickets, and, as a result of this knowledge, sturdy, straight limbed well-developed children are now decidedly in the majority. As a result of the teaching and practice of oral hygiene, it is now an uncommon occurrence to find a child with first permanent molars missing owing to dental neglect. With further education by physician, dentist and public health authorities, the time should not be far distant when oral malformations due to breathing obstructions, abnormal habits, premature loss of deciduous teeth and other preventable conditions shall be largely eliminated. The present-day theory of the use of psychology in the training and education of children is mentioned in the paper. While this is very necessary it is sometimes carried to extremes. If I am correct in my interpretation of methods proposed by some of the so-called child guidance experts, I can readily see why we may have unpleasant and serious problems in the management of some children. According to some of these authorities, there must be no restraint placed on the child and no compulsory submission to authority. A child should be led by precept, example and suggestion. They tell us that to prohibit a child's doing what he wants to do or placing any direct restraint on his actions will interfere with his proper mental development, thwart initiative, stifle ambition, etc., etc. While these methods may produce excellent results if all conditions are ideal, in a great many cases, the results will be far from satisfactory. Any one who has conducted an orthodontic practice for a period of years has his share of child patients over whom the mother apparently has little control, and these cases present problems which are not easily solved. In orthodontic treatment, the home care and cooperation are extremely important, and our first consideration in some of these cases should be the education of the mother to the necessity of proper control over the child to the end that instruction in home care be faithfully carried out. We are all agreed that the "fear emotion" is the one with which we must deal mostly in the treatment of children. Certainly, it is unfortunate that fear of the dental office is so thoroughly anchored in the minds of so many children. How to overcome this fear in the mind of the child, and, as Dr. Noland suggests, how to keep the child in a happy state is often a difficult problem. While the operator in his direct contact with the child may use various means to overcome this fear, a great deal may be done in this regard before any operation is to be performed. It would seem to me that to keep a child in a happy frame of mind, it is quite necessary to have a pleasant office. The surroundings should be such that the child will be attracted and interested. The waiting room may contain several small chairs which would be comfortable for the child. Books and magazines should be those of interest to children. Pictures on the wall may depict stories, persons or things with which most children are familiar. The nurse should be one who is really fond of children, who knows how to approach them and how to make them feel comfortable and at ease. The operating chair may be one designed especially for children and, of course, the operator himself must always be genial and pleasant. It is surprising how quickly children will notice that special provision has been made for their care and comfort, and, in many cases at least, I feel that their mental reaction to these things is very favorable. The operator should always be gentle and kind when performing any service for the child. Almost any operation necessary in orthodontic treatment may be done in such a way that the child will suffer little or no pain and not a great deal of inconvenience. The same operation may also be done in a careless and unskilful manner. The one method will lead to easy management of the child, while the other may mean that the child will become more difficult to manage as the treatment progressed. While the operator should always be sympathetic and kind, he should be firm with the child in doing those things which are necessary. He must always be master of the situation and the child should become aware of this fact early in the treatment. Honesty with the child is essential at all times. No promises should be made which cannot be kept. Informing the child that a certain operation will cause no pain when it cannot be done without pain will result in the child's lack of faith in the operator, which, of course, will be a decided handicap in further treatment. It is far better to in-

form the child that the thing to be done will cause pain, letting him know that you are sorry that it must be done and promising that you will be as careful as possible in doing it. It should be kept in mind that few children know anything about the procedure involved in orthodontic treatment and this unknown factor may cause anxiety and fear in their minds. Time should be taken to explain what is to be done, and all questions asked by the child should be answered. A great deal of fear and anxiety may be eliminated in this way, and it is time well spent. Whether or not a mother should be present in the operating room with the child may depend on the child and also on the mother. Some children, at least in the early stages of treatment, feel safer and more secure with the mother in the room, and, in these cases it may be advisable to have the mother present. Many children like to magnify pain or unpleasantness in the presence of the mother. Some mothers insist on telling how nervous the child is and how much he has previously suffered. These mothers are apt to be profuse in their sympathy when any thing is being done. Certainly it would be wise in these cases to have the mother in the operating room as little as possible. It is often necessary, in an orthodontic practice, to keep the child for an appointment of an hour or more. Such appointments should be made in the early part of the day when both the child and operator are in good physical condition and not tired out by the day's activities. Certainly, it is too much to expect a child to sit through a full day's school session and then be in proper mental and physical condition for a long appointment at the orthodontist after that time. Long appointments should be made during school hours. School authorities are almost all awake to the necessity for dental and orthodontic treatment and they should be ready to excuse children for this service when necessary. In most instances, the question of child management in an orthodontic practice is practically solved after the first few appointments. After that time, if properly dealt with, there are few children who should be a problem to the operator from the standpoint of management. Probably, too often, blame is placed on the child when the operator himself is largely to blame. There are undoubtedly men in the practice of orthodontia whose temperament and disposition is such that children in their hands will always be a problem. In these cases, it would be a question of the operator adjusting himself to the children rather than feeling that the management of the child is the problem. Irritation, worry and anxiety on the part of the operator are quickly detected by the child, with the result that the patient will become nervous, frightened and consequently difficult to manage. Dr. Noland's suggestion that we go the hilltop so that we may see the vexations and annoyances in the valley below and realize that they are only incidentals in the real business of life is one that we might all follow with a great deal of satisfaction. It is a philosophy which I saw stated in a few words a short time ago.

For every evil under the sun,
There is a remedy, or there is none.
If there is one, try to find it.
If there isn't, never mind it.

THE CONSERVATION OF TISSUE IN DENTAL ORAL SURGERY

By WILTON W. COGSWELL, D.D.S., Colorado Springs, Colo.

IN this day and age of spectacular accomplishments, while on every side men are gaining national and international fame by doing things in new and unusual ways, it is little wonder that our profession has produced its share of spectacular operators.

Not only does this apply to general dentistry, but it also applies to that particular branch, dental oral surgery. We witness clinics where men give examples of their skill, chiefly demonstrated by force and speed. Speed, it must be admitted, is of value; but strength, whether applied by muscular force or by instrumental design, has no place in successful dental oral surgery. While the tissues comprising the oral cavity have amply proved their ability to withstand punishment, force exerted in surgery of this part of the human body will result in trauma which will be followed by loss of tissue, either temporary or permanent.

The past has given us the turn-screw, the physics forceps and numerous crossbar elevators with which to accomplish this mutilation of tissue, and even yet the last named has its advocate. The chisel and mallet—of inestimable value, if used considerately—have been brought to disrepute by over-zealous masters. Repeated blows of the mallet, sufficient to cut directly into solid bone, will result, to some degree, in shock to the patient.

Where the osseous tissue is backed up by tooth substance, or a solid body of bone, the outline of the area to be removed should first be made with the bur.

The operative field of the dental surgeon, which is visible to the onlooker but limited as to view and light, offers little space for the spectacular in surgery, and speed is necessitated to impress on some the difference in operative methods.

Yet, the stopwatch can never be the criterion of good surgery, and while without doubt, there have been wonderful advances in the removal of teeth and the elimination of attending difficulties, the perception of such advances must be limited to those able to appreciate the delicate handling and conservation of tissues by the operator.

This cannot be seen by more than one witness, or possibly two witnesses, at one time. Therefore, the most spectacular methods are resorted to. Excessive speed demands force, and the results of force are trauma, fracture and shock, terminating in loss of tissue.

The patient presenting a full complement of teeth for the individual extraction of one or more should be viewed as a full denture subject of the future. The least damage in that area of extraction may eventually lead to misfortune in full denture retention. The careless

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operator who causes loss of investing tissues of the remaining teeth may unduly hasten that day.

Conservation of tissue applies to all tissues of the oral cavity and may be disregarded by that which is not done as well as that which is done.

In taking up the various points relating to this subject, we find it necessary to consider individual extraction and ridge preparation; but it being manifestly impossible to cover such a subject in so short a time, I shall mention only those points of trouble common to the average practice.

The hypothetically ideal ridge would be one having a broad, flat occlusal surface with semiperpendicular, slightly diverging walls; but as Nature will countenance no flat surface, but insists on curves, we must be satisfied with a modification in form.

Height we should have, a broad base, not a sharp but a rather well rounded crest, displaying roentgenographically an even composition of cancellous bone tissue, free from roots, cysts and residual areas, surmounted by a white crest line of condensation, denoting freedom from subperiosteal, pathologic irritation.

Visualizing the ideal in ridge formation, and realizing that force, with its attending laceration of soft and fracturing of hard tissue, will prevent such realization, what method should we use?

There has been considerable criticism of the commonly called open-view method of tooth removal. To anyone with experience, this criticism is absurd, as it offers the least trauma, time and discomfort and the most effective, in fact, the only effective, method of removing pathologic tissue.

Chief among the anatomic variations in normal cases, we find the heavy, beaded crest of the alveolar plate at the gingiva creating the most difficulty.

This bead, extending apically along the gingival third of the root, and sometimes several millimeters in thickness, offers an ideal railing against which the tooth, being thrown buccally or labially, terminates in fracture of the tooth.

When a tooth is being removed by such method, if this bead fails to spring sufficiently and the tooth does not fracture, the bead will fracture. Now, we must admit that the outer plate generally fractures, but the segment of the plate does not fracture in line with the form of the root being removed, but rather in the form of a half circle whose diameter points extend well over the adjoining teeth or sockets, and it sometimes carries the interproximal septum with it.

We all understand why it is impossible to create a normal extension growth on the completely severed end of a leg or arm; yet, by a well opened incision through the periosteum of the tibia, extending lengthwise, it becomes possible to remove a long section of bone, leaving the shell of periosteum intact and eventually expecting the redevelopment of resected bone.

The support of the surrounding tissues will tend to keep the periosteum in normal relation, and regeneration of bone within it takes place. This does not apply to the alveolar ridge when the alveolar matrix is destroyed. Here, we have a thin, soft tissue extending upward from the mucobuccal fold to cover the ridge, entirely dependng on the alveolar septums for support, the loss of which causes collapse of the soft tissue and periosteum, resulting in a low ridge, no ridge or a decided depression where a ridge should undoubtedly be.

Therefore, it is apparent that regeneration of bone can be expected only to that point to which the periosteum may be healthily supported through the regeneration period. If this alveolar comb surrounding the teeth is essential to the support of the periosteum, then force which is liable to cause loss by needless fracture must be abandoned. If an object is embedded within another substance, its removal as a whole must depend on the springing, fracturing, condensing or the cutting of a pathway for its passage. It would seem logical that the latter method should be the most attractive as we know the others are predisposing causes of postoperative pain and slough.

Success in the use of the flap depends on a clean-cut incision, designed in such a manner as to maintain blood supply and assure a broad table of bone underlying the incised margins when approximated for suturing. This requires consideration of the area to be operated in, for the incision must necessarily be over an unoperated bone plate, either mesially or distally or both.

It is best made at an angle, with a reverse angle starting at the interproximal space adjoining the tooth to be removed, leaving the gingiva of the adjoining tooth intact.

Retraction of this flap exposes the outer plate, and with light blows of the mallet, a notch is cut through the alveolar bead sufficiently large to allow the root to be tipped outward with practically no pressure. It need not be more than the gingival two-thirds of the root unless we are dealing with a decided root curvature of hypercementosis. This triangular notch can be made surprisingly narrow and still allow passage of the root, thereby permitting the retention of all interproximal septum and outer plate, which may be trimmed in multiple extraction, to any desired ridge curvature for support of the periosteal flap.

The exceptions to its application arise at times in the lower second and third molar region, owing to the extreme forward extension of the external oblique line, and also in the upper second and third molar region, where we sometimes see the extremely low zygomatic and malar formation. In these cases, the bead notch should be extended only to the point of bifurcation and, if necessary, the roots divided by a bur.

Suturing of the flap into position after operating is best done with an insoluble suture. For this, medium sized horsehair, placed in the sterilizer at the beginning of the operation so as to become pliable and threaded with a reverse through the eye of the needle, will be found superior to any other. Its ability to remain for long periods within the tissue without the slightest irritation far exceeds any other. All cases, whether sutured or not, should be observed for a day or two, and removal of the suture is but a second's work and generally unknown to the patient. The only objection to horsehair is found in the tie ends, which, if allowed to extend beyond the knot, will be felt by the cheek. A double close tie will avoid this.

One or two sutures will adequately close the average flap.

Removal of the four anterior teeth, as a rule, requires little more than rotation to release them, but the cuspids offer great resistance in many cases.

It is here, under old pressure method, that, on disengaging the tooth from clinging soft tissue, we often found a large section of the buccal or labial plate still attached. The immediate result was collapse of the overlying soft tissues of the cuspid prominence. Besides leaving

the sharp edge of the fracture attempting to protrude through, we obtained, in this manner, an unjustly narrow ridge at the angle and severe postoperative pain.

Upper first biscuspids, usually subject to fracture of the lingual root under old methods, are removed with ease through a buccal notch. And should an occasional fracture develop, the lingual root removal is simplified, as is the case in fracture of upper molar roots.

Rotated bicuspids, presenting their broad, flat or slightly concave distal or mesial surface to the buccal side, fracture under slight pressure, but the buccal notch will eliminate this trouble. Hypercementosis or decided curvature of the apical third requires only the extention and enlarging of the notch to permit removal.

Of course, a large percentage of teeth to be removed are already broken down or decayed to a point below the gingiva. It becomes necessary to establish a surface for a forceps grip or to resort to the wedging with elevators. The preferable method in avoiding trauma involves use of the buccal notch, and on the lingual side of the submerged root and within the tooth substance, a mesial distal notch is cut with a bur. This allows the lingual beak of the forceps sufficient grasp to tip the root outward. The sinking of a small hole at a slight angle into the fractured root tip, inaccessible to any forceps beak, will allow the dislodgement of the remaining tip. Very often, it will slip outward with the bur, if the engine is stopped with the bur still buried in the root.

For rapid removal of root tips, or, in fact, any oral surgery, it is far better that the assistant have an electric suction pump. This not only gives constant vision but also eliminates one of the objections to the use of the bur; that is, the tooth cuttings, as it is possible to irrigate the area without a drop of water falling into the mouth.

Many times, root tips are picked out of their sockets as easily as the cuttings; which brings to mind a realization of the lack of actual adhesion of teeth to the investing tissue. Rarely do we find actual attachment.

Consideration of this fact constitutes the first step in tissue conservation. Some angle of impingement is the true retentive factor in their resistance to removal. The perception of this eliminates force.

Removal of the lower first molar at times approximates the difficulty of an impaction, and extreme damage may be done.

With chisel and mallet, the outer plate is removed to the bifurcation, and by the use of a new cross-cut bur at the point of exposure of bifurcation and cemento-enamel junction, and cutting upward and inward, the division of roots and their removal becomes simple.

If the roots are fractured below the plate level and it becomes necessary to use elevators, as it often does, it is far better to use that design of instrument which is to be inserted between the roots as the loss of the inter-root septum is of much less importance than loss of the interproximal, as its height is so much less.

The lower third impaction, according to angle and depth submerged, offers untold difficulties. The use of the chisel alone for its removal has caused a vast number of cases of permanent dimple-like depressions at the distal buccal corner of the second molar. Such depressions, besides being retentive points for débris, extremely hard for the patient to dislodge, result in root exposure and eventual decay.

Chisel removal of the buccal plate should be extended only as far as to expose the normally distal buccal angle of a horizontal impaction and of the bone overlying, back to the cemento-enamel junction of the upper surface of the crown. From this point, the removal should be accomplished by aid of straight handpiece cross-cut bur, the use of which in the rapid division of tooth substance is an art much abused, but easily mastered if strict attention is given in detail.

Heat, the cause of postoperative pain and slough, must not be excessive.

A new bur in a sterile handpiece—and a handpiece may be made sterile—should be used. Its application to the occlusal or heavy enameled surface of any tooth meets with little success; but once entrance is gained to the crown, the cutting is rapid in any direction.

The bur should always be inserted at, or slightly below, the cemento-enamel junction. From that point, the dividing slot may be extended in any manner desired.

Attempting to cut down on a hard surface is responsible for the traveling of the bur, or jumping into the soft tissue, and mutilation of soft tissue is the result. Once inside the enamel, rapid, safe cutting is assured.

Cutting with a bur should be limited to tooth substance. Never should it enter the encapsulating bone, and here, again, with the bur inside the crown, the surrounding enamel of under and outer surfaces offers an easy guide to depth and position; for it is nearly as difficult to cut from within outward through enamel as the reverse, provided the tip of the bur is maintained toward the circumference of the crown, thus playing upon the inner end of the enamel rods rather than against their sides.

Fracture of the tuberosity in the removal of the upper third molar may result from excessive pressure distally or buccally. Hand pressure chisel reduction of the buccal plate, nearly always possible, will permit buccal extraction.

Cysts, residual areas and pathologic involvement of the antral floor should be approached with extreme caution. Operation, in these cases, demands the removal of bone to a point of complete access, necessitating constant attention to retention of ultimate flap support and wound closure.

While drainage of cysts and residual areas is essential, the immediate closure of antral perforations is indicated, and, if necessary, the antrum should be irrigated by nasal puncture.

Extensive loss of ridge form and bulk is noticed in cases of upper cuspid impactions when the impacted tooth is removed at the same operation as are the remaining upper teeth on that side of the arch. So much of the palatal buccal and labial bone matrix is lost at this time that collapse of the ridge is very liable to occur.

The remaining normal anterior teeth will support the palatal flap if the impacted cuspid is removed first and ample time is allowed for regeneration of bone. In fact, this practice of avoiding large undermined areas liable to collapse should be carried out in all operations of the osseous tissue of the oral cavity.

Retention of the lower anterior teeth in an otherwise edentulous mouth, creating traumatic occlusion of the upper anterior denture, results in loss of ridge form and leads to development of the soft tissue roll at the upper ridge crest. This disadvantage far offsets the value gained in the retention of a lower partial-denture, as this denture is but temporary,

and full denture retention is accomplished with difficulty later.

Hypertrophic nodules of the palate and lingual bicuspid areas interfering with proper adaptation of dentures should be removed.

Constant irritation from denture friction may result in a chronic condition of inflammation.

Roentgenographic examination of the ridge crest in old edentulous cases, giving a history of tender gums and inability to masticate, will, in many cases, disclose lack of condensation of the bone structure, or it will present a subperiosteal lacy appearance with tiny spurs or spires forming the ridge crest. These spurs, the result of improper ridge preparation at the time of total extraction, and lack of calcification owing to constant inflammation and irritation, must be removed.

Many muscle attachments of the mucobuccal fold of the ridge are nothing but pathologic adhesions. They give continuous trouble, and if their cause is not recognized, are allowed for by muscle trimming of the denture.

Roentgenographically, they seem to present an area of rarefaction in the ridge at the point of attachment. Sometimes, this area is of only minute size. The origin of these areas is apical granulommatous tissue extending through the buccal plate, probably of long standing.

It is common, on dissecting back the flap over the apical area of the buccal roots of upper bicuspids or molars, to find a pathologic aperture.

On removal of these teeth and failure properly to curet the apices, the balance of the socket will fill with healthy bone; but this aperture will allow the granulomatous tissue to adhere to the buccal gum tissue, and a fibrous muscle-like formation will develop between the mucobuccal fold and the ridge at this point, remaining indefinitely.

Raising a flap and curetting this area of all pathologic tissue and clipping from the inner surface of the periosteum the extension-like tissue will cause this attachment to disappear, and the mucobuccal fold will assume its normal position.

In many cases, it is impossible to correct the uneveness of the ridges to such a degree that the impression will not cause the denture to have high and low areas. In untrimmed cases, the abruptness of these are by far greater.

Dentures worn over long periods without proper checking up and, if necessary, relining will utterly destroy both form and composition of the dental ridges. Though there are patients able to withstand the discomfort of what we know to be ill-fitting dentures with seeming unconsciousness, the ridges suffer the abuse and eventually rebel.

Education of the public to these facts, the answer to this problem, rests upon our shoulders. It is the intention of this paper to suggest for your consideration a few of the small problems that are presented in everyday practice. They may call to mind many more which to you may seem of greater importance.

General dentistry offers many opportunities for conservation of tooth structure, yet the rights of the investing tissue should never be forgotten. Our work, though practiced on a small portion of the human body, comprises an immense field.

The psychologic effect of undergoing dental treatment produces, in many instances, a condition that is far from normal. Shock may manifest itself as the result of thoughtless abuse, in ratio to the patient's mental and physical condition.

Ideas are new but today and obsolete tomorrow; yet it would seem but right that regard for useful tissues of the body be of paramount importance to all.

Delicate manipulation of instruments does not indicate the hesitancy of fear nor lack of skill, but rather the mark of a studious, thoughtful surgeon, keenly conscious of responsibility toward the physical and mental welfare of his patient.

DISCUSSION

M. Hillel Feldman, New York City: I was interested in hearing Dr. Cogswell speak of preserving the cervical cone. A piece of gauze, no matter how sterile at the moment of application, becomes septic. Especially is this noticeable when the patient leaves the office on Saturday and goes out of town for a week end. The problem presented I think I have solved in the preparation of a wax. This I don't intend to market, but I wish to make a report to the profession for its application as employed in my own practice. I have made up a preparation containing the same drugs which I used on gauze: orthoform and aristol, each 5 per cent, petrolatum, 3 drams, and simple ointment, to make 1 ounce. This wax, when properly prepared, has the same consistency as beeswax which has been slightly softened. In the heating of these ingredients, the temperature should not be elevated to more than 75 or 80 degrees. Any greater heat will precipitate the iodin out of the thymol-iodid. The jar in which the material is then placed should be previously heated. These instructions are important as they explain why the wax has frequently been too crumbly and hard. By applying that to the socket of a tooth, we eliminate the odors which the gauze will accumulate within a very short time, and as Dr. Cogswell has pointed out, we preserve the periosteum at the ridge for the regeneration of bone. In very deep cavities produced by the removal of cysts, I have been able to retain the labial matrix, even without the use of sutures, which I think is an added advantage in the hands of a general practitioner. I do little suturing, and I did little even before the application of this wax, but since using this wax, I have found that the labial mucoperiosteum which has been reflected in the course of the operation has become united at the point of incision, provided the incision was made clean, and none of the contact tissue has been destroyed. I am surprised that I rarely hear of the Williger knife in oral surgery discussions. The Williger knife, was, I believe, called to my attention by Theodor Blum as long as twelve years ago, and I have been surprised, in my contacts with men out of town, that they never have heard the name. I recently watched a man operating out of town, and he made a flap on the labial surface of a maxillary molar, using the Bard-Parker knife. The operation was done under general anesthesia. You realize that the heel of a knife will cut the lower lip in making such a flap. The Williger knife eliminates that. It can be used in all parts of the mouth. There is no cutting whatever on either side of the knife. It affords a very simple method of making the flap. The knife is placed directly against the bone and cuts easily by actual contact if it is kept very sharp.

Boyd S. Gardner, Rochester, Minn.: I am sure that you will expect me to come to the defense of the mallet and chisel. For the past ten years, we have made use of these instruments rather than burs or drills. By keeping daily records of all patients operated on, including postoperative roentgen-ray records, we conclude that the service rendered is far better than when revolving instruments are used. Perhaps more dentists would come to the same conclusion if they would compare the results obtained with the different types of instruments. Moreover, if they would keep daily records of all patients operated on rather than only those who report to their offices for postoperative treatment, more valuable data would be accumulated. By the use of chisels and a mallet, much time is saved, and their use makes it far easier to maintain the chain of asepsis in our work. However, a sharp drill would be superior to a dull chisel. It is found necessary to sharpen instruments daily in order to obtain satisfactory results. I quite agree with Dr. Cogswell that the curved incision is superior to the straight, and we are indebted to James A. Blue of Birmingham, Ala., for this suggestion. I believe that horsehair would be far superior to plain catgut for mouth work. With the improved catgut, which is hardened by tannic acid and put in triple "o" size, we find that we obtain very satisfactory results.

The fact that they do not have to be removed is an advantage, as patients can be

dismissed with them in place; and this appeals to the majority of patients, as there is a universal objection to the removal of sutures even though it is a simple procedure. In order to obtain satisfactory results by the use of the mallet and chisels, one must have had considerable experience. In third molar work, I am sure that we leave adjoining teeth and process, in general, in very much better condition.

Menefee R. Howard, Denver, Colo.: The method by which anything operative is accomplished may vary. Possibly, there may be considerable variation in every one. The end results are the things that count, irrespective of the method or variations. I live near Dr. Cogswell and so I have had opportunity to know that the end results of his work have been good. With me, No. 7 twisted silk is the suture of choice. The reason is, first, its ease of use, and, second, that it can be removed easily without disturbance to the patient. The next point is a matter of conservation of tissue. Sometimes it is advisable, owing to certain conditions, to use a packing. I have used a preparation for twelve or fifteen years, which has given most definite results. This can be used in postoperative treatment of sockets, and where there is pus, also in the first stage of osteomyelitis, which is the breaking down or dry socket. This preparation is orthoform and aristol, equal parts, iodin and oil of cloves, equal parts, mixed to the thickness of a creamy paste and used with iodoform gauze. This will effectively control postoperative conditions. The oil of cloves being penetrating, its proportion is increased in cases of pain, the iodin being increased proportionately in cases of pus, soreness or exposure of bony process.

Dr. Cogswell (closing): The difference of opinion in regard to desirable sutures is, of course, based on the greater ability to handle one suture. I have been extremely fortunate in the use of horsehair, but any suture properly applied is satisfactory. The use of the bur I do not advocate to any great extent, as I brought out in my paper. But I also find that the small clippings from the use of the chisel as well as the cuttings from a bur are very apt to remain within the socket unless a suction pump is used. The use of the suction pump will completely clear all the débris from bur-cuttings and also the small clippings that result from the use of the chisel. Without the use of a suction pump, it would seem to me that a bur would be a very poor instrument to use in the mouth. The bur is used for the purpose of avoiding the destruction of an extensive amount of bone at the buccal side of the impacted third molar. Dr. Gardner brings out the point that the depression at the distal buccal corner of the second molar does not prevail in his postoperative results with the use of the chisel, and no doubt that is correct. But I have had occasion to observe a great many cases in which the chisel was used, and I do not agree with him as to the average case that comes in for postoperative observation in which the complete chisel technic has been used. There is but one thing necessary to convince me that this depression results in a large percentage of cases rather than in a small percentage. In a crown to root impaction, which is decidedly more difficult than a crown to crown impaction of a lower third molar, to release a third molar by chisel work alone must require a vast amount of cutting that is unnecessary. A line drawn through the normal distal root of a horizontal impacted third molar compared to a line drawn from the apex of the same root to the normal mesial cusps of a horizontal impacted third molar is considerably different in length. To remove the tooth either bucally or superiorly without fracture of the tooth itself must require such a degree of force that the apex of the superior impacted root must be forced distally the distance of difference between the length of the two lines drawn. Unquestionably, the point of the hinge action of the tooth in movement is at the apex of the superior impacted root. Therefore, it requires a distal movement at this point to permit the mesial cusps of the crown to swing upward or the lingual cusps to swing buccally. It becomes necessary to uncover the superior surface of the crown to such an extent that the cemento-enamel junction is exposed or it will require a decided amount of pressure from the mallet to fracture the crown through the enamel with the chisel. But to fracture the crown successfully with the chisel, a sufficient amount of bone must be removed on the buccal to permit a chisel to be placed in contact with the buccal surface of the crown for proper fracture. And if successful fracturing is accomplished, it requires an extensive amount of cutting on the buccal surface to remove the bone, retaining the convexity

of the crown itself sufficiently to permit its removal. A rapid cut with the bur part way to the pulp on the superior surface of the crown will permit a thin bladed elevator to fracture the tooth, the sections being easily removed and the roots slipping forward without extensive sacrificing of the buccal plate. The complete removal of a third molar in the case of a crown to root impaction without the removal of a portion of the crown seems to be a physical impossibility unless there is needless trauma at some point, either at the apex of the superior root where the close proximity of the mandibular canal presents great possibilities of harm, or at the distal buccal corner of the second molar, where extensive destruction of the buccal plate will result in a retentive depression for débris. There is no questioning the fact that a great many of the second molars are ruined at this point by both bur and chisel, but we are speaking of proper consideration for the bur when it is used in a correct manner and to a minor degree.

ECONOMIC FACTORS IN THE MANAGEMENT OF A DENTAL OFFICE*

By CHARLES R. LAWRENCE, D.D.S., Enid, Okla.

THE subject, "Economic Factors in the Management of a Dental Office," is one of wide range, and to attempt to deal with any of its many phases in a detailed manner would require more time than is available. Therefore, my efforts will be confined largely to trying to arouse a greater interest in and to lead to a closer study of this important subject by the individual dentist. That there is a great need for this is evidenced by the fact that far too great a number of dentists reach their declining days in somewhat strained or needy financial circumstances.

I fully realize the significance and importance of the professional duty of the dentist. Under no circumstances should he allow the economic phase to overshadow the professional side of the question. I make this statement in the beginning because, in the past, whenever the word dollar has been mentioned before our dental organizations, a large number of listeners expected the speaker to put on the "soft pedal" and whisper it softly.[1] Many men in our profession and other professions have been so outspoken as to say that it was the wrong thing for a true professional man to consider such a sordid thing as money, that all his energies and efforts should be centered on the scientific and service side of his calling.

This, to my mind, is an unfortunate attitude. It has been responsible for many men in our profession who have worked hard and rendered good service reaching the brink of life suffering humiliation, deprivation and want. This has been the lot of far too many of our fellow practitioners who deserved a better fate, and it should serve as a warning

*Read before the Section on Operative Dentistry, Materia Medica and Therapeutics at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 23, 1928.

1. Johnson, C. N.: The Economic Problem—How Shall Dentists Meet It? J. A. D. A., 11:307 (April) 1924.

to those who wish to avoid such experiences.

There is a sane, common sense and humanitarian way for the average dentist—and it is the average dentist with whom we are dealing—to avoid such experiences. There are various reasons for the present economic status of the rank and file of the dental profession and one of the foremost of these is that we have not come to a realization of the fact that the practice of dentistry is a business as well as a profession.

Every profession is a business, but not every business is a profession; hence, if dentists expect or hope to improve their economic status, we must consider the practice of dentistry from a business, as well as a professional, standpoint. Possibly one of the principal reasons why presentations of this kind have been frowned on is the fact that far too many of the papers presented before our organizations have been written by commercial men, who have ignored the professional side of the question.

Any appeal to the financial side only that makes the dentist believe that he is justly entitled to a wonderful income, irrespective of whether he is rendering service, is absolutely wrong. On the other hand, it is equally wrong to render service without some consideration of the financial side.

It is a noble thing to serve humanity and, while pure idealism is one of the finer things of life, to be too idealistic not only may cause impoverishment of our own lives, but also, in many cases, the devastation may become more complete and extend to persons near and dear to us.

There are two principal types of dentists: not the ethical and the unethical, but the honest and the dishonest. The dishonest dentist's sole object seems to be to extract a few more dollars from the unsuspecting patient without any consideration of services rendered. The honest dentist puts service above all, and, far too often, forgets everything else. The records on the two pages are about equally divided; in other words, 50 per cent of the dentists are in the "leech class" and are already receiving more than their just share of compensation for services rendered, and many on the other page are, for various reasons, not balancing accounts. It is to the latter class that we will turn our attention at this time.

WHAT IS SUCCESS?

Success in any endeavor consists of something more than making money, but as viewed by many people nowadays, since it no longer is considered a virtue to be poor, this is a part of success. The dental profession has no monopoly on high ideals: this is a quality that is found in many men in all walks of life, even those who are financially successful.

Dr. Kells, in his splendid book,[2] which every dentist who is interested in office management should read, says: "Real success in dentistry means, as I take it, that after a life spent in honest endeavor and consistent and constant application, one has been able to make some provision for that fateful 'rainy day,' has gained the respect and confidence of all those with whom he has come in contact, and, best of all, has won and still holds amongst his fellow members of the profession the reputation for fair dealing and honesty of purpose."

This is a splendid definition for success in dentistry. Many dentists attain partial success, but few attain complete success as defined above. The greatest stumbling block in our way in attaining

2. Kells, C. E.: The Dentist's Own Book, St. Louis: The C. V. Mosby Company.

complete success is in being able to make some provision for that fateful "rainy day."

"There's a reason," a reason that can be corrected, but it requires the same diligent study and application that improved technic or any other advancement requires. Wishing for it will not bring it about as there is no place in dentistry for the easy life.

To my mind there are many qualities necessary for success in dentistry, such as ability, industry, judgment, honesty, cleanliness, personality and business acumen or skill in office management.

A dentist may have great ability and never attain success. He may have ability plus industry and not attain success. He may have great ability, industry and judgment and not be rated as a successful dentist. We may grant him ability, industry and judgment plus cleanliness, honesty and personality, and still he may fall short of being a financial success because of his poor office management or business ability.

It is unfortunate that this is the state of affairs confronting the dental profession in the United States, the most prosperous country on earth and the world-wide leader in dentistry.

Possibly, we can more fully realize this fact by a study of Table 1. First, it might be well to state what we mean by "office management." Office management may be defined, in a general way, as all those factors that enter directly or indirectly into the production and distribution of our services not connected with our actual ability.

Some of the things that may be specifically mentioned are:

Planning the office.
Equipping the office.
The book-keeping system.
Collections.
The records and case histories.
Training the assistant in her numerous duties and responsibilities in a way that will harmonize with our efforts.
Determining the question of fees.
Purchasing materials.
Planning the work.
Management of patients.
Selling our services.
Eliminating lost motion.
Balancing the productive and unproductive work.
When and when not to extend credit.
Appointment cards.
Broken appointments.
Telephone calls.
Examinations.
Conservation of time.
Investments.

To attempt a complete analysis of Table 1 would require considerable time. The main object in presenting it here is

TABLE 1.—SELF ANALYSIS

	1	2	3	4	5	6	7
Ability	100	75	65	50	95	40	30
Industry	100	80	85	100	100	70	50
Judgment	100	65	75	70	50	30	40
Cleanliness	100	75	85	100	50	50	75
Honesty	100	90	90	40	85	60	30
Personality	100	60	75	100	45	40	100
Office Mgt.	100	85	50	70	25	35	0

to show that office management is a great factor in the financial success of the average dentist and to refute the idea that if a man possesses ability, the financial rewards will take care of themselves.

Any dentist of a few years of experience will readily recognize that each of the things mentioned in this table is an important factor in his success. Possibly the least understood of these are judgment and office management.

Judgment is necessary if the highest purpose of professional success is to be reached, the lack of which causes many of us to fall by the wayside.

Column 1 is for comparative purposes only. In columns 2 and 3, the rank and file of the dental profession is represented by two different types of dentists. Each

is fairly well balanced, and down to "office management," they will be about equally successful financially. They have reached the same point economically speaking but have traveled different roads to arrive at this place.

As to whether they have a good road to travel over from here on during the "rainy day," depends altogether on whether they take the 85 or the 50 per cent route in office management.

Considered from an economic standpoint, there is no question in my mind that the higher grades on industry, judgment, cleanliness and personality of the man represented in column 3 will more than offset the difference of the two men in their ability.

But give the man in column 2 a grade of 85 per cent on office management and number 3, 50 per cent on office management, and number 2 will come under the wire far ahead of number 3 in the economic race. If we choose to reverse these two figures, the results will be reversed.

In columns 4 and 5, we have two extreme types of dentists represented. Neither man is well balanced, both are hard workers, one has great ability, yet I dare say down to the point of office management, number 4, from an economic standpoint will be as successful as number 5. Then, if we give number 4, 75 per cent on office management, and number 5, 25 per cent on office management, number 4 will win the race.

This is not only an unfortunate state of affairs for number 5, but it is also unfortunate for the people of the community in which he lives; for I do not believe that any dentist will go along year after year rendering good service under poor economic circumstances. Number 5 is a discouraged man, and yet if some of his industry were directed in the right channels, he could put himself very much in the running and be a benefactor to the people of his community.

We have another group of dentists represented in numbers 6 and 7. These men do not expect much of themselves; neither does any one else. The only reason they can continue to prey on the people is because the law allows them to call themselves dentists; hence, they, and not the people, are protected. They are in a race by themselves, and it matters little which one of them wins.

OUR GREATEST WEAKNESS

Undoubtedly the greatest weakness of the rank and file of the dental profession, in the foregoing analysis, is office management. I have proved this to my own satisfaction, in a number of instances, by having dentists of different groups grade themselves according to Table 1, first requesting that they do not sign their name to the card, and that they be honest in their grading.

This was done after a detailed discussion of the part each of the foregoing factors play in the success of the dentist. In practically every case, the recorded figures show the general average on office management to be far below the combined general average of the other things listed on this chart, and on many of the individual cards, the grade on office management was the lowest recorded. I feel sure that if we could do the same thing in this audience, our findings would be duplicated.

Now, if this is a true state of affairs, and to my mind it is absolutely correct, why should the dental profession continue in this way when it is a matter that can be corrected by the same individual and cooperative efforts that we employ in solving many of our other problems?

The team that usually wins is the one that is well balanced. To have a general average of 75 and to be well balanced is far better than to have a general average of 75 and have too many weak spots. Of course, occasionally, a dentist may make a "touchdown" with weak office management in his lineup, but that may come a long way from winning the game.

THE CAUSE OF OUR WEAKNESS

If a good business man has some weak departments in his business, he proceeds to find out the cause and then corrects these faults. Not so with most dentists. There is a lot of lost motion, energy and effort in many dental offices, and the confusion that prevails in the management of these offices results in continual playing at cross purposes. Disorder is incompatible with any attempt to put into execution many of the things that mean greater success.

Far too many dentists fail to realize this fact. They go along from year to year blindly, self-satisfied; let the office run itself, and allow the little details which might be made powerful aids to be neglected or fall into disuse.

"Systematic men are always in closer touch with every detail than slip-shod individuals who know little of their business, and it matters not how great may be the practice, a complete cognizance of the minor details is essential."

We are inclined to wait until we are struck by lightning on some "rainy day" before we become aroused to the importance of these things. It is true that much of our weakness along this line is due to lack of training by our dental colleges, but I am pleased to note that the colleges are seeing the need of this thing and are making an effort to strengthen this weakness.

One of the principal causes of this weakness is the failure of dentists to keep books as they should be kept. I once heard Governor Lowden make this remark, "Years ago, while an attorney in Chicago, I found that many of my clients who went to the wall did so because they could not bolster up sufficient courage to look their balance sheet in the face. Tender souls of this type shrink from things that shock them, failing to realize that the only way to overcome unjust conditions is to seek first to understand them."

And so it is with us: if we are to overcome our unjust conditions, we must seek first to understand them. The very first step toward seeking to understand these conditions is through the bookkeeping system.

Dentists are notoriously poor bookkeepers. A great majority of us keep books on a "scratch-pad basis." I doubt that 10 per cent of us know what it is costing to produce our services as a whole, and when it comes to the different departments of our work, we know little or nothing.

I once had an income tax man tell me that of all the men who are supposed to keep books, the dentist is about the poorest bookkeeper of the lot. Dental supply houses inform me that a surprising number of their customers write to them about the first of each year to find out how much their account amounted to the previous year.

How far would the business man get without a good bookkeeping system? Not very far: it is his sheet anchor. Then after we get and use the bookkeeping system, what must we do? Have the courage to look the whole story in the face and not be so tender hearted as to shrink from the things we find, even

though we may be shocked for the time being.

What are some of the things many of us will find? Cost of conducting the practice far above what we thought it to be. A long list of unproductive work. Collections below what they should or could be. The actual productive hours cut down to about one-half the working hours in the office. The wrong proportion of living expenses to net income. Too long a list of poor investments.

THE QUESTION OF FEES

I hardly need say to you that the popular impression that dental fees are exorbitant and dentistry is a highly profitable profession is wrong. On the other hand, the most reliable information that we have been able to obtain shows the average income of dentists to be small for the necessary training and investment.

The fee question is an individual and a community problem. Every dentist of every community should have a minimum fee schedule. We should know where the danger line is and never get beyond it, and every dentist must figure this out for himself; not by the time-worn guessing-contest system but on the basis of common-sense bookkeeping.

Fees are usually based on whatever is customary in the community. These customs are quite often foolish ones of long standing and were never founded on a sound economic basis.

We need only to cite foolish custom number one, which has been so prevalent all over the country, of extracting from one to thirty-two teeth free of charge for the privilege of making a patient some plates or dentures.

Now the exodontist, who is usually a better business man than the general practitioner, receives about as much for his services as we have been receiving for both services. These foolish customs have brought into dentistry what we term productive and unproductive work.

If there is any sane, common sense, humanitarian or business reason why the honest dentist should have to continue to work many, many days each year for about what it costs him, or even less than it costs him, to render conscientious service, I do not know what it is.

One of the greatest needs of office management at this time is to get the dentist to know and understand more about the productive and the unproductive work. This is the place where we are woefully weak and are using poor judgment in not maintaining a better balance in the different departments of our services.

The unproductive work varies in different practices and different communities. Some of the most common and almost universal things found in this list are:

Treatments and root canal fillings.
Free examinations.
Children's dentistry.
Prophylactic work.
Treating pyorrhea.
Collections.
Broken appointments.
Cement fillings.
Night calls.
The shopper.
Free services.
Stopping toothache.
Free consultations.
Come back and work over.
Snap judgment.
Diagnosis.
Lost motion and time handling patients.

Good business demands that there not be too many unproductive departments to sap the vitality of the productive departments. Ninety per cent of the dental practices are burdened with too much unproductive work, and it is poor

business for any one to continue this state of affairs.

So if we move all or even a part of the unproductive work over into the productive column, we will be more successful and render a better service.

Gilpin has said, "I hate a thing done by halves. If it be right, do it boldly, but if it be wrong, leave it undone." It is undoubtedly right that we move the unproductive work over into the productive column, so why not do it boldly?

STOPPING THE LEAKS

The economic problem is not so much a matter of increased or large fees as it is one of correcting the evils or plugging the leaks already existing. The first step in this direction should be in getting rid of the unreasonable or unjust things. Most people are fair minded, and if we can get them to see our point of view, we will not have so many leaks to contend with.

It seems unreasonable that the busy dentist who spends at least 2,000 hours in his office each year should find that he has had something like from 1,000 to 1,200 productive hours, which is about the average.

Let us analyze the matter of broken and late appointments. Broken appointments are a bugbear in every dental office and a big drain on our finances. It is safe to say that 75 per cent of the services rendered by dentists are by appointment, and much of this time is lost by patients failing to keep these appointments promptly if at all.

This is a very unjust situation and one that the profession as a whole is doing little or nothing to correct. My observation leads me to believe that not to exceed 25 per cent of the dentists are using any form of appointment cards, and many of the cards in use fail to stress the importance of keeping appointments promptly.

Much can be done by the individual dentist and still greater results accomplished by the dentists of any community adopting and making use of a uniform educational appointment card. Something along this line is effective. After the usual blank spaces, name and location of the dentist, add under the head "Important":

> The time indicated on this card is reserved especially for you, regardless of the number of persons who may desire our services at that time. Therefore, you will be expected to keep this appointment promptly.
>
> If for some reason you are unable to keep the appointment, please notify this office at the earliest possible moment so the time may be allotted to others.
>
> Failure to do so causes great inconvenience and loss of valuable time to the dentist, for which charges will be made, unless you comply with this request.
>
> This office is on a cash basis, and you will be expected to pay for your work at or before completion. Patients who do not desire to conform to the foregoing rules should make it known before the work is begun.

These should be printed on flexible paper (not card paper) on one side only. The assistant should fill in the blank spaces and give every patient an appointment card. When appointments are made over the telephone, a card should be mailed that patient.

This is simply another link in the economic chain, and one that is appreciated by the patient and produces good results.

The big and important problem of children's dentistry never will be solved until the economic problem along with it is solved. The barber who cuts the child's hair receives more for his services than most dentists receive for services rendered the same child. The superintendent of dental activities in our state department of health informs me that one of

the most discouraging things she has to contend with is the fact that dentists will not take care of the children after she has urged the parents to take them to the dentist.

The root canal problem is just as much an economic problem as it is a scientific problem. The dental profession has been economically burdened with this thing for years, and it is little wonder that they are avoiding dealing with it on the slightest pretext.

At times, we like to compare ourselves with the medical profession, and here is an economic comparison. I have asked hundreds of dentists this question: How many of you men receive as much for a night call as the physicians in your community? The answers show less than 3 per cent. The dentist is certainly entitled to just as much as the physician for this service, yet very few of us get it, owing, I suppose, to another foolish custom among dentists.

Another big leak is free examination and free consultation. Free examination is one of the big farces of dentistry, and it is little wonder that this is one of the poor services rendered by dentists.

The extra ten to thirty minutes which we give to people without consideration in the fee charged, is the thief which robs us of the leisure and freedom from worry to which we are justly entitled.

The long-standing custom of cleaning teeth, regardless of the condition of the mouth, for an insignificant set fee should be discontinued. We should at least receive a manicurist's price for such work.

Another growing and unjust situation confronting us arises when we have people come into our offices and ask us to look over roentgenograms. The roentgenographer has received a good fee for his services: the dentist usually receives nothing. How long are we going to let this leak continue?

Another tremendous leak is to be found in our collections. It would be a fine thing for us and for the people whom we serve if we did not have to worry about, and spend time making collections; but we may as well face the situation as we actually find it. The installment plan of buying is getting to be more and more of a menace to the professional man, and woe unto the dentist who fails to throw aside some of his professional dignity and put his collections on a sound business basis.

The average dentist who loses from 5 to 10 per cent of his gross charges through poor collections is swamped economically; for that is just about what his net savings will amount to. Most practices that are conducted on a business basis will show collections amounting to nearly 99 per cent plus.

The best collecting agency in the world is a clear and distinct understanding with most patients as to just about how much the services will cost and the method of payment, before beginning the work. Do your part of charity work, but make the people who can pay fulfil their part of the obligation.

The practice of dentistry, at the most, is not an easy task. "The exactions of daily practice with their constant physical and nervous tension take a toll which should be cheerfully paid for in adequate coin of the realm and they will be so paid for as soon as we and then the people become convinced that it is right to do so."

The dental society has an important duty to perform in educating its members along this line, and when this is done, instead of many of our members doing the wrong thing, more of them will be doing the right thing.

There is seemingly so much to be done that most men say it cannot be done. We cannot keep the birds from flying over our heads, but we can prevent them from building nests in our hair.

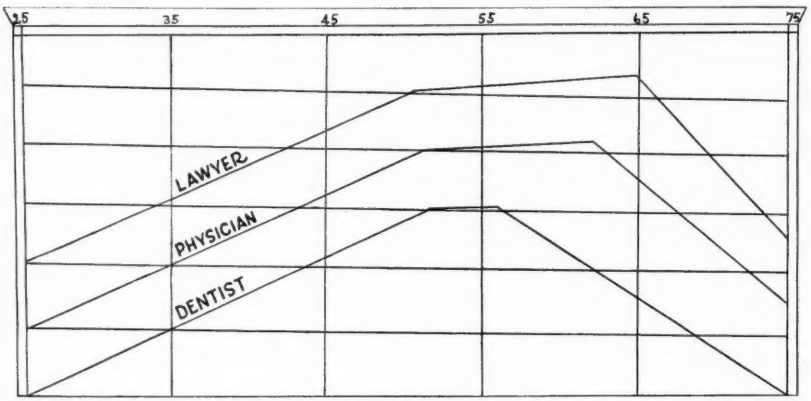
The accompanying chart and Table 2 show additional reasons why some dentists fail to provide for the "rainy day." The chart shows the financial rise and decline of the average dentist, physician and lawyer as based upon their professional earnings.

If we take three young men, one in each of these professions, and give them equal degrees of success in their respective professions, we will find their financial rise from 25 to 50 to be constant and about on an equal plane.

This does not mean that they will make an equal amount of money; for if this were the comparison, the dentist would probably be in third place. It means rather that the length of time over which the dentist can maintain his normal professional usefulness is much shorter than that of the lawyer or the physician.

Physical infirmities are likely to account for the difference; for when the eyes of the dentist become dimmed and his hands begin to shake, he starts on the down-grade, while these handicaps do not affect the lawyer or the physician to so great an extent as they affect the dentist.

The average lawyer or physician can reasonably expect to maintain his normal professional usefulness from 45 to 65 or even longer; while the dentist, at not later than 55, can reasonably expect the line to take a sharp turn downward.



Years of greatest earning capacity for the dentist as compared with the lawyer and the physician.

This is something that few dentists ever take into consideration in their fee basis, and it is a cogent reason why it should be one of the aims of every dentist to so shape his affairs in the early days of his professional life that ample provision will be made for his declining days.

The dentist who fails to establish himself well financially before he reaches the danger line at 55 does not have much chance to make the grade. It is pathetic to see a dentist struggling under great

handicaps in an effort to come back financially after the age of 55.

Table 2 suggests some of the reasons why a great many dentists are playing a losing game. On this chart, we have some figures put out by the United States Treasury Department.

The stingy man, the spendthrift, the thrifty man, which class are we in?

I have never come across many stingy dentists; in fact, most dentists spend freely and gladly without any judgment as to what their limit should be except when it comes to paying their dental society dues. If this is true, it puts many of us in the spendthrift class, and here it might be well for us to "stop, look and listen," and turn toward the thrifty man's road.

TABLE 2.—HOW SOME MEN DIVIDE THEIR INCOMES

	Stingy Man Per Cent	Spendthrift Per Cent	Thrifty Man Per Cent
Living expenses	37	58	50
Education	1	1	10
Giving	1	1	10
Recreation	1	40	10
Savings	60	0	20

It takes a tremendous effort to slow the spendthrift down to the point where you can show him that he is in danger; that old age and poverty are an ill mated pair; that every dentist must look to the time when he can work no more; that only a gnat plans to live but one day, and only a grasshopper makes no provision for the cold and dark just ahead. He mistakes motion for progress. He is very much like a squirrel in a cage, the faster he runs, the harder he has to go. Possibly, he would get along faster, if he would go slower.

A dentist earning $300 a month cannot travel a $400 a month gait and accumulate anything. Likewise, a person making $600 a month cannot keep up with the $10,000 a year crowd and have an easy chair to sit in at quitting time. A competency is not made under that plan.

In the course of twenty-five years, one dentist will have about as much of the unexpected, for example, in the way of illness in the family, as another. So, in the long run, most of us have an equal chance to lay up something for the evening of life, especially if we get into the thrifty man's class. No one has much respect for the stingy man or the spendthrift, so why not get into the thrifty man's class?

Thrift does not mean that we should stop spending, but it does mean the ability to manage our money carefully or judiciously, spending less than we earn or saving systematically. To cultivate thrift, we must learn to designate between luxuries and necessities and not let our judgment be swayed by the seeming pleasures of the hour.

Many dentists have been working hard for twenty years and are not any farther ahead financially than when they started out. Take the case of the young dentist who is hopeful against poverty in old age. The amount of money or property he has next year doesn't mean much. What he will have five years from now means little more. It is what he will have thirty years from now that counts. Therefore, he must look thirty years ahead and strive to arrive by that time.

The man who looks ahead gets ahead and stays ahead, and the dentist who does not heed the warning signals is likely to get behind and stay behind.

SUMMARY

1. Every dentist owes it to himself and the people whom he serves to render the very best service of which he is capable, and the degree of this service

will depend on his ability, industry, judgment, honesty, cleanliness and office equipment.

2. The rewards we receive for services rendered, in most cases, come in the form of a monetary consideration. Therefore, the practice of dentistry should be considered from a business as well as from a professional standpoint.

3. We should and do have at least as much respect for a man who has some money honestly gained as for the man who has no money at all. In other words, it is no longer a virtue to be poor.

4. Ninety per cent of the dental offices are inefficiently managed; hence, a large number of dentists can increase their income very materially by better office management.

5. It is far better to stand out in your community as a man with a good credit rating than to possess a worn out automobile.

6. It is not necessary to sell dentistry at sensational fees. It is only necessary to put the nonproductive work at the same price as the productive work.

7. Remember, we cannot receive just "fees" through the time worn guessing contest system.

8. A long list of unproductive work will keep any practice down to a low financial basis.

9. It is very easy to make ourselves think that we will not have to face some of the problems of life that are almost sure to come to us, and whether some of the "rainy days" are to be followed by sunshine will depend on whether we heed the warning signals.

10. Far too many of us are inclined to put off until tomorrow what we can and ought to do today.

Therefore, let us (1) render full and fair value to our patients in the shape of our very best services; (2) know and put into execution every detail of proper office management; (3) have the courage to ask a fair and honest fee and persist until we get it.

DISCUSSION

John S. Owens, Camden, N. J.: It is a notable fact that the dental profession possesses only a few books that might be termed standard textbooks on dental economics, although numerous articles have appeared, over a long term, in our dental periodicals covering practically every phase of the subject. The paper of Dr. Lawrence is a distinct contribution to this subject, with the analysis and graphic portrayal of our shortcomings and their correction in the management of our dental offices. Emphasis must be given to the professional attitude on this subject. The measure of a professional man's success was beautifully stated in the quotation from our revered Dr. Kells. The question that we should ask ourselves is "What sort of success do we desire?" The man whose sole aim in life is a big fee, a large income, a big bank account is a miserable failure in a profession devoted to the healing art. The practitioner who cannot take time to attend dental meetings, take part in the proceedings of his local, state or national society, assist his professional brother or give attention to research work or teaching, unless he sees financial gain, who is wrapped up in the scramble and greed for his own advancement, is an unworthy member of the profession. The man who takes no time to keep his body healthy, his mind broad and his disposition sweet is a flat failure, no matter how much of a material success he may be. I wish to lay particular stress on the growing tendency on the part of some dentists toward the commercial attitude. This must be repudiated by the profession before it undermines the true ideals of our calling. What are these ideals? They are exemplified in the lives of the outstanding characters in our profession, many of whom have died in the harness, yet, shabby harness, but their memory lingers with us, indelibly written on the pages of history of our profession. They have given unstintingly of their accomplishments and substance for the betterment of mankind and have reaped the glory of service. We must not forget that we belong to this group, devoted to the art of healing. Success is

within the grasp of every man, even to the most menial or humble of us, but the point of view must not be warped by the dollar mark. With the appalling lack of information on the elementary principles of this subject, on the part of the general practitioner, it is apparent that local dental societies should form study classes for the proper dissemination of information, with due respect to the professional aspect. I regret, with Dr. Lawrence, that much of the so-called information on this subject of dental economics is coming from commercial sources and not from the profession. Let us carry with us into the study of this subject what Thomas P. Hinman has epitomized in the words "truth," as indicating the attitude toward ourselves, and "service" as the attitude toward our patients. Dr. Lawrence's paper strikes the keynote "know thyself," and he graphically, in his analyses, brings to our attention the necessary qualities that constitute a successful practitioner. In his definition of office management, I cannot see how we can divorce our actual ability from this department, for our office management is intimately connected with our capacity, power to perform or skill. Certainly, our ability enters into the training of our assistant, determining fees and planning work. For the vast majority of us, the weakest link in the chain of our qualities undoubtedly and the easiest of correction is office management. All one has to do to bring this point home, and what to my way of thinking constitutes a necessity for the majority of us, is to employ regularly a certified accountant to check up our bookkeeping systems. While much has been rightly stated under the head of unproductive working hours and turning these hours into the production column, we must not forget that a definite amount of time daily must be spent at the desk planning and managing the practice, watching the office system, studying efficiency, cost of production and collections and determining the margin of profit. While the hours spent this way are not rightly classified as productive hours, they remain the key to the office management, by close observation of which any and all leaks are detected. No mention is made of liability insurance. It is a well known fact among professional protective insurance companies that an ever-increasing number of suits are being preferred against professional men. The attitude of the public is "go ahead and sue, he is covered by insurance" and woe unto the man who has not stopped this leak if he ever gets caught, for a life's savings may be lost in a single slip. There remains another leak, the drain on one's physique, which, if not stopped by its rightful remedy, recreation, will end your calling early in life, or will shorten your days, lessen your skill and enthusiasm, befog your mind, will take the pleasure out of the service and make your disposition such that you are neither fit to practice nor to live with. Only those that have gone through this experience know the wisdom of the truth that a sound mind and a sound body go together. Under the head of savings: if you join the thrifty man class, having determined the amount, save it each month; for if you wait for a surplus to show on the right side of the ledger, experience has taught that you will go on waiting. To quote Ed Howe. "We heard a man say today: 'If a man wins success, he must fight for it.' Is that a fact? We sometimes believe it is not—that success is easier than failure. If a man will be modest and honest, and reasonably industrious and careful, he cannot very well avoid being successful. The men who are successful simply work away, take care of what they earn and make no bad breaks. Finally, success comes—not always in great measure, but enough to satisfy a reasonable man. Most men who make a failure of life are not content to wait; they become impatient, and make a bad break, in which there is an element of trickery, if not downright dishonesty. Then people lose confidence in them, and they soon acquire the habit of saying that industrious and worthy men who have succeeded are thieves."

C. C. Sparrow, Minneapolis, Minn.: I have been for some time greatly interested in the business side of our daily work and have been astonished at some of the findings. Dr. Lawrence half apologizes for presenting a paper on this subject before a Section of the American Dental Association. He should be commended for his effort, for it is high time that we should, as a professional body, awaken to the necessity of giving this question serious consideration and thought. Changes in business, social and economic conditions in the country at large make it imperative that we get away from some of our old customs that have long since become antiquated. For our self-preservation, we are compelled by the very change in the

order of things to give strict attention to this great problem. We must so conduct our offices that we may be able to live a life in keeping with that of a true professional man, and, at the same time, be able to save a competence for that proverbial rainy day. We must have high ideals in order to get the very best out of our work, but I know of no other one thing that will kill that wonderful spirit so quickly and surely as lack of money. No man who is financially embarrassed and lives in mortal fear of the bill-collector can do his best work and render his best service to his clientele. I cannot agree with the classification of "honest and dishonest dentists." I cannot believe that in this day and age even a dentist could be so near-sighted as to think that dishonesty could possibly bring him financial returns for any length of time. It is true that many men are receiving more than their services justify, but this is due more likely to ignorance or fear rather than to downright dishonesty. I would term the man dishonest who is giving a wonderful service to his patients for starvation fees. This man is dishonest to his family and himself and is maltreating his fellow practitioners. Dr. Lawrence dwells, to quite an extent, on records, bookkeeping systems, etc. To my mind, while they are necessary, they are not so important to success in dentistry as he believes. Dentists fail for many reasons, and one of the greatest reasons is the failure to keep in constant touch with patients. We may complete a case today for a patient in a most satisfactory manner, and the patient is loud in his praises of us as dentists. He thoroughly appreciates the painstaking care we gave his work and the long hours we spent on his case, in order to give him the splendid result obtained, but unless we keep in touch with this patient in the weeks, months and years to follow, he will very likely drift to another man. Time makes us forget many things, and this is no exception with dentists and their patients. We should have each patient report to us regularly for prophylaxis and examination. This will keep up that constant contact, allow us to watch our work carefully, to see that it is working out as we had planned, keep us constantly before that patient and give him a service worthy of the cause and in keeping with a just remuneration for that service. This will help cement the tie of friendship and respect for us as true professional men, and earn for us the reward it deserves. This system is being carried out in a few offices today, but their numbers are far too small. In most cases, when an extensive reconstruction case is completed, and it is working well, the patient does not return for months and years, if at all, or until something bothers him. This may be when something serious has happened. This might have been easily avoided had the patient reported regularly for examination. When something serious has happened, and it is necessary to remove a large bridge, or worse yet, a tooth to which the bridge is attached, and the patient is again obliged to undergo considerable distress and at great expense, he loses faith in his dentist and dentistry. Why not avoid all of this by regular inspections, at which time we are paid for a service to keep in condition not only the mouth, but the work that we have placed there, thereby extending the life of our dental work and creating a much more favorable impression of our service and of dentistry in general? Broken appointments should not, in my opinion, be charged for, except under the most unusual circumstances. A charge for a broken appointment practically always leaves a bad taste, and does not help one to cement the professional tie and create the friendly feeling so necessary for continued patronage. Impress on the patient, in the very beginning, the necessity of being prompt and the reasons why, and you will have no trouble with the average patient. If a patient has a reputation of always being late and breaking appointments, take that into consideration when making the fee and you will have much better results. Most men lack volume in their business. This volume will never be increased by bookkeeping systems. For the man who has more than he can do and fails to make money, it will help, but for the man without a volume of work, it means little. We must get new patients and hold the old ones, and this, to my mind, is most important. Every man should have a roentgen-ray machine in his own office. He should learn to use it, and use it often. Charging for examinations will ruin the average man, unless he does something definite for the patient. If we do our own roentgenographic work, we can then incorporate this as part of our routine examination, and get paid well for our time. To charge for an examination alone is ruinous to any practice. Pa-

tients do not like it and will avoid it, as we would, should the conditions be reversed. To be successful, one must be willing to work and work hard. He must be honest and give the best that is in him. He must know the kind of service that he is giving, and if it is not up to standard, he must learn to bring it up. He must be a man. He must learn to handle people well, and sell his professional service at a figure that will be fair to his patient, fair to himself and fair to those depending upon him. In closing, I want to quote to you a little creed which I think would help us all to be more successful:

"I take no thought of my neighbor's birth,
Nor the way he makes his prayer.
I am willing to grant each human a place on earth
If his game be on the square.
If he play straight, I will call him mate,
If he cheats, I will drop him flat;
For all rank but this is a worn-out lie,
And each clean man is as good as I,
And a king is no more than that."

INLAYS*

By HERMAN A. MAVES, D.D.S., F.A.C.D., Minneapolis, Minn.

THE answer to Herbert Spencer's question, "What knowledge seems of most worth?" is surely "That which conserves the health," and the teeth play a fundamental part in this conservation.

Since our study, teaching and research, up to the present time, have been unable through preventive measures to check caries, it undoubtedly is obvious to all of us that we, as a profession, must continue our efforts to perfect our mechanical technic, for we are called on to deal with existing conditions, the ravages of decay.

Therefore, an exposition on casting and a practical demonstration carry with them a deep significance and a keen responsibility, stimulating all of one's efforts. To me, these opportunities, made possible through the splendid organization of the American Dental Association, are a distinct privilege, and viewed in the nature of a privilege, they necessarily entail a strict obligation. Too often, in the past, metallurgy shrinkage and expansion of waxes, investments and golds, has been largely ignored, and our castings fit fairly well in spite of us, rather than because of us.

We are all keenly aware of the outstanding fact that any new procedures which tend to depart from the old, however inadequate the old may be, are not usually met with much enthusiasm. On the contrary, it is the rule that they are accepted slowly. It is not easy for the men who have been doing things in a certain way—teaching and advocating certain methods — to renounce them, much less to admit the fallacy in the things that they have been teaching and executing.

We are all prone to meet progress reluctantly, especially if it demands that we cease doing things in the manner in which we have been doing them; and, as we grow older, we are likewise reluctant to take up the new, even though we

*Read before the Section on Operative Dentistry, Materia Medica and Therapeutics at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 23, 1928.

are able to see its application and advantages. This is all too human; nevertheless, it is a great privilege to be connected with a progressive movement. We must develop and bring into action creative impulses, for dentistry has been challenged. In order to be a man, one must take a full step, even if obliged to stand alone, for the upbuilding of the casting process.

I feel confident that courage, enthusiasm and perseverance have brought final success to dental castings. Of all human attributes, openness of mind, with eager expectancy of new discoveries and a readiness to remold convictions in the light of added knowledge and dispelled ignorance and misapprehensions, is the noblest, rarest and most difficult thing to achieve.

To conserve time, I am going to confine my remarks to the final results that Dr. Meyer and I have attained during the past five years. I trust that, in their final analysis and application, we may epitomize our deductions relative to the casting process, whereby standardization is in sight; and that we may be capable of rendering a service by perfecting our mechanical technic in reproducing wax patterns in gold, a technic which has suffered much criticism, and justly so, since Dr. Taggart gave it to the profession in 1907.

The casting process is at present in a transitory stage and about to undergo far-reaching modifications which will distinguish it radically from the casting process of the past. The imperfections in dental castings, most of them regarded popularly as perfections, are practically all products of the present generation. The transition from the past imperfect restorations to those nearly perfect is now apparently a simple matter.

The latest addition in the "control of variables" is the attempt at standardization of investments, wax expansion, wax elimination, drying of molds by electricity, and casting into a hot mold with from 15 to 20 pounds pressure, thereby producing smooth velvet-like castings, inside and out, linear measurements, and uniform results which can be easily slipped into place on porcelain or steel models without retouching, an extremely severe test.

In this swiftly moving, mechanical age, when the pressure of a button turns on lights, starts fans, sweeps floors, washes clothes, sets dynamos to humming, and speeds words across continents and oceans, we are sometimes prone to feel that an individual counts for little. At times, he seems to be a mere cog in a machine, a puppet at a play. He fills his little day with fuss and furor and passes off the stage. Fortunately, no one is indispensable. It would be a sorry world if things went awry when individuals ceased to function. Others fill the vacant places and humanity moves on.

Despite the vast array of mechanism in the modern world, one comes every now and then on such clear instances of personal influences, of creative individualism, as to renew one's belief that behind apparent mechanism is a personal influence and guidance. Instances of this kind, I found in Drs. Taggart, Van Horn and Meyer.

Wax expands on heating and contracts on cooling. Those are facts we all know. This expansion or contraction amounts to about 0.1 per cent for every 5 degrees change of temperature of the wax, more or less, depending on the wax used. Those changes we cannot disregard, if we wish to employ the material to our best advantage in our work.

Plaster of Paris, we are told by Dr. Harder,[1] of the University of Minnesota, expands slightly on heating, but contracts from its original volume, sometimes as much as 1 per cent, on being cooled after it has been brought to an excessive heat. Since Plaster of Paris is an important ingredient in all our investment compounds, those also are facts that we cannot disregard.

1. Harder: Dent. Cosmos, 68: (Dec.) 1926.

All alloys of gold in our use shrink as they pass from the molten to the solid state. The shrinkage is about 1.5 per cent, more or less, depending on the alloy used. This is still another fact that we must consider if we are seeking the best results in our work.

All the foregoing facts regarding the casting process have been disregarded by the majority for the last twenty years. And what have been the results? We all know: large inlays and crowns that can never be properly seated; wide open margins that harbor decay when the cement has washed out; uncovered gingival margins due to mesiodistal shrinkage; compression of the fibrillae of the dentin, causing soreness of the tooth and often death of the pulp; buccolingual expansion of the tooth, often causing fracture of the buccal or lingual cusp; and all of the annoyance and trouble that goes with trying to fit round pegs into square holes.

Step by step, we have worked out a technic in which we can utilize to our advantage some of those factors or forces which have always worked to our disadvantage. But, in order that you may be able to understand the reasons for every step in this technic, and that you may make the best possible castings with the fewest failures, it will be necessary for me to enumerate certain fundamental principles and explain them in detail.

1. The thinner the wax model, the less the gold casting will shrink. As the gold passes from the molten to the solid state, it must reach a certain state of solidity before it is able to compress the investment and shrink in spite of it. The thinner the bulk of gold, the nearer to the solid state it must be before it can compress the investment and shrink in spite of it; and, consequently, the less shrinkage is registered between points that tend to bind. Conversely, the bulkier an inlay, the more it registers shrinkage between points that tend to bind.

2. The thinner the occlusal portion of a mesioclusodistal inlay, in proportion to the mesial and distal portions, the less shrinkage from mesial to distal aspect. If the occlusal portion is thin and the mesial and distal portions are bulky, the occlusal portion will begin to congeal and shrink before the mesial and distal portions. It will complete a great part of its shrinkage before the mesial and distal portions are hard enough to overcome the resistance of the investment. Hence, the inlay will register less shrinkage from mesial to distal aspect. The converse is true if the mesial and the distal portions of the inlay are thin and the occlusal is bulky.

3. The more the wax model is chilled while held in position in the cavity, the less binding there will be in the cast gold inlay. When chilled, wax tends to shrink, but it cannot shrink where the shape of the cavity is such that the tooth prevents it from shrinkage.

In such a case, there must be a rearrangement of the molecules of wax to conform to conditions, or an elastic tension is established with a tendency to contract when the model is removed, or both. The former takes place largely in the early stages of chilling, while the

latter takes place more when the wax becomes fairly hard. The elastic tension is largely overcome by softening the wax with a hot instrument some place between points that tend to bind.

If the chilling is carried far enough with a large wax model on a metal or porcelain tooth, the wax will check when the tension becomes too great.

4. The warmer the investment when it sets, the more expanded the wax model will be. This expansion in turn compensates in a measure for the shrinkage of gold.

5. The larger the sprue hole, the longer it takes for the gold in it to congeal and the greater the amount of gold that can be fed through it before the gold casting passes the mushy stage; consequently, the denser the casting will be and the less the shrinkage. This is the main advantage of the centrifugal machine over the pressure machine.

6. The shorter the sprue hole, the longer the gold in it will remain molten, and, consequently, the greater the amount of gold that can be fed through it before it congeals. Hence, the less the shrinkage will be.

7. The better the ring fits the crucible former when using warm investment, the less the danger of distortion of the wax model. Theoretically, there should be no water or investment allowed to escape from the base of the ring, causing a settling of the investment, nor any movement between the ring and the crucible former in handling. This is best prevented by a ring fitting into a groove of beeswax on the crucible former and fitting so closely that the crucible former can be picked up by taking hold of the ring.

8. The thicker the investment when mixed, the denser and harder it will be and the longer it will resist the pressure of the cast gold as it passes from the molten to the solid state. Hence, the less the shrinkage registered in the cast gold inlay between two points that tend to bind.

9. The more plaster in the investment, the harder the latter will be and the more it will resist the pressure of the congealing gold as it shrinks. Hence, the less the shrinkage will be.

10. The less heat applied to the mold when eliminating the wax and the moisture, the harder and denser it will be and the more it will resist the pressure of the congealing gold; likewise, the less the shrinkage of the gold, and the smoother the finished casting.

The fact that the harder investments of a higher plaster content cannot be heated to a high degree without destroying their life and resisting qualities accounts for a critical stage in the wax eliminations. With large gold castings, it is very difficult to eliminate all the wax without danger of overheating the plaster.

The percentage of moisture in the mold is not always the same, nor the amount of wax to be eliminated, nor the gas pressure. A great share of this difficulty can be overcome by eliminating most of the wax, or all the wax, before subjecting the mold to the flame, and by bringing the mold to the same point of saturation with moisture for all castings. This is done by a very simple device consisting of a small receptacle containing water sealed in by the base of the mold and so arranged that the water when heated must be forced through the mold, carrying the wax with it.

11. The less foreign matter incorporated in the wax that remains in the mold, the smoother the casting will be. If the wax is forced out through the sprue hole in a softened mass, without being al-

lowed to soak into the investment, all particles in the wax which might be left as residue in the carbonization are likely to be carried out with it.

12. The denser and harder the investment, the greater the pressure necessary to force the air out of the mold and the gold into it. It is here that the pressure machines have the advantage over the centrifugal.

13. The denser and harder the mold, the greater the pressure that it will stand without injury in casting against it.

14. The greater the pressure that can be used in casting, the greater the amount of gold that can be fed into the mold while the gold is congealing and, consequently, the less the shrinkage.

15. The larger the button of excess gold in proportion to the size of the castings, the longer it will remain molten. Hence, the greater the amount of gold that will be fed into the mold before the casting congeals and the less the shrinkage.

16. The sooner the gold is cast after being brought to a state of fluidity, the smoother will be the casting, and the better the condition of the excess gold for future casting.

17. The lower the carat of the gold, the lower the melting point is likely to be, and, consequently, the less the shrinkage.

18. The less the inlay binds, or compresses the fibrillae of the dentin, the less the danger of fracture of the tooth or soreness or death of the pulp.

All these fundamental principles have been discussed at length and they all constitute common knowledge in a condensed form.

Briefly, our technic for investing a wax model and eliminating the wax and the moisture from the mold is as follows:

Fill the groove on the crucible former with beeswax. Then, insert a little beeswax into the sprue hole and insert the sprue supporting the wax model. This will prevent the wax model from moving when being painted with investment.

Place about a cubic inch of Meyer and Maves investment at the right end of a large glass slab. Fill the large end of Taggart scales with Taggart investment and balance with warm water. Note this very carefully: If the wax model to be invested is for a full crown, use the water in the bottle in the wax expander at about 150 F. If the wax model is for a bulky mesioclusodistal inlay, dilute the water to about 140 F. If it is for a thin mesioclusodistal molar inlay, a mesioclusodistal inlay for a bicuspid, a mesioclusal or a distoclusal, any small inlay or a three-quarter crown, do not use water over 115 or 120 F.

Make the mix in the small bowl fitted to the wax expander. Stir with a spatula enough to see that the mix is of the right consistency, a heavy cream, and complete the mixing in the recess provided for the bowl in the wax expander. Leave the whip mixer in the bowl until the max model has been covered with the inner investment. From a water syringe, place a quantity of water on the glass slab covering a space about the size of a dollar or a little more. With a spatula make a mix of water and Meyer and Maves investment of such consistency that it can be piled up fairly high without flowing. Draw off about a third of this and add to it more investment powder until it is as heavy as you can conveniently paint on the wax model. After painting a little of this on the cavity side of the wax model, rasp the crucible former with a file. Paint on some more of the heavy investment and rasp some more. This causes the heavier

particles of the mix to settle, producing a dense surface next to the wax model. It also causes the bubbles and water to rise.

Then, complete painting the wax model with the thinner inner mix, covering it to the thickness of about one-sixteenth to one-eighth inch, or a little more, and fill in clear down to the crucible former.

Place the warm ring taken from the wax expander into the groove on the crucible former with a rotary motion. The beeswax in the groove will seal the joint.

Make two turns of the mixer and pour the outer investment. Note this carefully: If the invested model is for a crown, it should be placed on the grate in the wax expander. If it is for a bulky mesioclusodistal molar inlay, place it on another ring in the wax expander. If it is for smaller inlays or a three-quarter crown, place it on top of another ring in the wax expander with the door slightly open, or on the top of the wax expander. Always remember that the thinner the wax pattern, the less the expansion necessary. This is especially true with partial veneer crowns.

Allow to set about forty minutes before eliminating the wax and the moisture. I time this with an x-ray timer. When set, remove the mold from the wax expander and level off the closed end. Remove the crucible former and sprue. See that the rubber washer is in place in the lower end of the mold compartment of the wax eliminating boiler. Fill the boiler with warm water and place the mold with the sprue end up in the upper compartment. Hold the mold tightly against the rubber washer and empty all surplus water. Screw on the top part of the boiler so that it holds the mold tightly in position against the rubber washer. Place the boiler in the electric eliminator, or any other eliminator serving the same purpose, and leave until the water boils and no more wax emerges from the sprue hole. Then, remove from the electric eliminator and allow the water to continue to boil for a minute or so. The whole elimination process for wax should not take over five or six minutes.

Turn the boiler upside down and cool under tap water. Remove the mold and place it in the electric eliminator with the sprue hole up. If a full crown or a three-quarter molar crown is to be cast, leave the mold in the eliminator until all the moisture has disappeared from the sprue hole, as shown by subjecting the open end of the mold to a mirror. If the crown is exceptionally long, leave it a minute or two longer.

There is a good scientific reason for this procedure. I believe that most dentists have cast crowns in which flaw holes appeared in the occlusal portion. Close analysis of this will explain the reason. In eliminating either the wax by the carbonization method or the moisture alone by our method, it takes longer for the heat to reach the end of the core inside the crown than to reach any other part of the mold. It follows, therefore, that if any of the wax or moisture in the mold fails to be eliminated, the failure will be at the end of this core or on the inside of the occlusal portion of the crown. When the molten gold comes in contact with the remaining wax or moisture, there is a sudden expansion of gas produced by the heat from the molten gold, causing a hollowing out of the casting and sometimes a hole through the occlusal portion. This does not occur so frequently when the carbonization technic is employed.

Practice has shown that by lengthening the time of elimination, when a crown is to be cast we will, to a large extent, obviate the foregoing trouble. If an inlay is to be cast, the mold should be removed from the eliminator while a quickly disappearing cloud still appears on a mirror placed against the open end of the mold.

The elimination of the moisture should take from sixteen to twenty minutes, this varying slightly with a slight change of temperature of the eliminator and with the size and shape of the wax pattern.

Before casting, the mold is placed in the wax expander for from one to three minutes to allow any trace of smoke or vapor which may be invisible to escape.

If this process is carried out carefully, a mesioclusodistal molar inlay or a full veneer crown which is smooth inside and outside and will go to place with finger pressure on a porcelain or steel model can be cast. Owing to the fact that the foregoing technic, in the hands of the average dentist has often failed, I believe that a simpler and more successful method will, in the very near future, be worked out, employing a single investment and disregarding the elimination of wax by boiling.

I wish to take this opportunity of expressing to Drs. Taggart, Van Horn, Price and Meyer and the Bureau of Standards my appreciation for their timely research relative to the perfection and standardization of the technic in the casting process. I feel that the profession also owes them an everlasting debt of gratitude. Roosevelt well said, "Every man owes some of his time to the upbuilding of the profession to which he belongs."

Revolution is the demand of evolution. In this age, the wheels of progress are turning rapidly. Today passes and tomorrow comes with added problems and new designs. The highway leading toward the goal is open. Dentistry is in step with the procession.

CONCLUSION

I wish to suggest the perpetuation of the name of William Taggart by our profession for giving it the casting process, whose perfection is in sight, for the welfare of humanity and the advancement of dentistry. Obviously, a strong desire for this perfection is now felt by earnest workers in the profession, and the time is noteworthy because of Dr. Taggart. "Yet hath my night of life some memory; my wasting lamps some fading glimmer left." Such an ideal was accomplished when he composed the casting process out of the inner consciousness of inspired dentistry, and little tampering has been done up to the present time with its sovereignty.

The vista continues to widen and new problems, new theories, new viewpoints loom large before us.

In completing one discovery, we never fail to get an imperfect knowledge of others of which we could have no idea before, so that we cannot solve one doubt without creating new ones.

DISCUSSION

A. L. Wilkes, Los Angeles, Calif.: When I first received Dr. Maves' paper, I doubted his ability to expand wax patterns in a way to compensate for the contraction of gold to such an extent that he could cast shoulder crowns to fit on porcelain stumps that would go to place by finger pressure alone. I considered that he had laid himself open to attack, and if it had not been my good fortune to see Dr. Maves and Dr. Meyer's demonstration in Los Angeles my discussion would have been very different and I should have been sorry of it. I do not consider that a man is qualified to discuss a paper until he has had an actual and thorough demonstration of the subject to be discussed, as it

is often misleading and confusing and a great deal more harm than good may accrue to an audience that has heard only the paper and has little time to digest and assimilate it. A large number might even be prevented from attending a clinical demonstration which would prove a great benefit to them. Unfortunately, this has happened in the majority of cases, and I see no remedy for it. Dr. Maves and Mr. Meyers are obtaining results that were unbelievable to me until I had seen their clinic. It is founded upon scientific principles and known facts as regards the physical and chemical actions of the substances with which they are working. The outstanding feature of their success, as I see it, is the expansion of wax, but this expansion must be kept under control at all times. It is very possible to overexpand it. The size of the pattern must be taken into consideration. It is an operation that requires an exacting technic, and while some of the steps in their technic might be carried out in another way with equally good results, it would be only confusing to mention them at this time. I will say that inlay technic will not and cannot be standardized until we employ means that will tell us the heat of our gold alloys at the time of casting.

Charles A. Furrow, Tulsa, Okla.: When notified that I was to discuss this paper, and after receiving the copy, I made a trip to Minneapolis and stayed three days with Dr. Meyers and Maves to acquaint myself thoroughly with this technic. If each of you could spend a like number of days with these men, you would enthuse about the wax expansion technic as I have. In discussing this paper, I am not unmindful of those who pioneered in this work before us. For twenty-three years, outstanding men have given us their suggestions for improvement, and with it all there has been little advancement over Taggart's technic and teaching. I am glad that one of the early pioneers on the wax expansion theory has brought into being this workable technic. In the pioneer work on wax expansion technic, they were seriously limited and handicapped in making direct application of the principles involved because of the lack of proper data on the different elements entering into the technic. Our improvement of inlay casting technic will soon far exceed the two most fundamental steps, cavity preparation and wax manipulation. True, I am not discussing this phase of inlay casting, but the fact confronts us that, with all of our casting perfection, we still cannot hope to make real inlays without improving the steps leading to the final casting operation. I believe these two men are pioneering in this field, and I am not unmindful of the men before us, such as Van Horn. These men may have expressed a theory or given us an idea, but the man who puts it into execution is the man who should receive greater credit for it. I can appreciate the fact that these men were working back in times without the knowledge of the control of variables that they encountered. The elements involved were not worked out on a scientific basis or worked out on facts as we have it today. I shall not at this time discuss different variables from the standpoint of figures, but I will say this: If you could see the various materials involved scientifically tested under workable conditions, you would have a greater respect and regard for their use than you have at the present time—you would give greater attention to detail. It might be well that you refer back to your February, 1927, issue of THE JOURNAL, and not only read, but reread Dr. Souder's article on "Control of the Variables," which will give you a greater conception of what takes place when working the material. With the knowledge at hand, I believe that it will soon be possible to make accurate castings, and by a most simple technic, assure definite control, eliminating the personal equation and thereby simplifying the whole procedure. As I see it at this time, three important factors enter into this technic: the handling of the wax, the investment and the method of expanding the wax pattern. The facts presented in this paper are going to be a great stimulus to us all, and will result in many men working to perfect and simplify the method of procedure. It is a fact that we can cast mesioclusodistal inlays that go to place beautifully with finger pressure, and without impinging or compressing the dentin. We have made a casting on this steel die that goes to place with finger pressure. Dr. Maves said in closing that the personal element enters into this to a certain extent. I believe that this is the beginning of a new era in inlay casting. A more definite technic will result, and one in which the personal equation will be wholly eliminated, making it a simple and accurate procedure.

Dr. Maves (closing): I had the privilege of visiting Dr. Wilkes in Los Angeles, and

I marveled when I saw the thousand castings that he had made to determine what degree of temperature should be used in casting. He has also worked out an instrument by which, when a button is pushed, he can control the temperature, and thereby, each casting can be made at any desired temperature.

UNERUPTED CUSPID: REPORT OF CASE

By C. S. BRAZDA, D.D.S., Berwyn, Ill.

A man, aged 51, had had all teeth removed, preparatory to the making of a denture. He came in three months later, declaring that he felt as if a piece of root were present in upper right cuspid region. The tooth, so he said, had been broken off in extraction thirty years before.

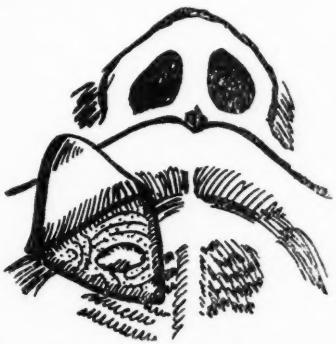


Fig. 1.—Field of operation.

A roentgenogram revealed a fully developed cuspid, lying in an oblique position with the tip of the crown partially erupted through the bone. The gum was not pierced, only a slight bulge being present.

The region was anesthetized by an infra-orbital injection and a lingual injection, after which a V-shaped incision over the bulge was made. The flap with the underlying periosteum was then reflected off the exposed bone. (Fig. 1.)

The bone to the mesial, distal, labial and lingual aspects was then removed with a bone drill, the entire crown being exposed. (Fig. 2.)

The tooth was then removed with cuspid forceps. When the normal hemorrhage ceased, one suppository was inserted in the socket, and patient was dismissed.

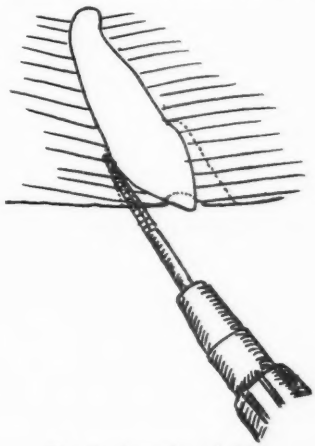


Fig. 2.—Insertion of drill.

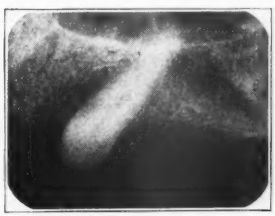


Fig. 3.—Tooth in situ.

There was no postoperative pain, and the socket healed in a very short time.

6304 West Roosevelt Road.

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C. N. JOHNSON, Editor

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Editorials

THE NEED OF A PERMANENT HOME FOR THE AMERICAN DENTAL ASSOCIATION

There is nothing that adds more to the material stability of an individual than to own a home of his own. It constitutes him at once an integral unit in the community, and gives him more self respect. Not only that, but it creates respect on the part of others. To call a man a householder is to add to his prestige among the people, to give him an established status, and to classify him as a responsible citizen.

What is true of individuals is largely true of associations. The moment any association establishes itself in a house of its own, it takes on a standing and a dignity that is never possible as long as it leases its quarters and pays rent to a landlord. In a certain sense, paying rent is an extravagance. The statement is sometimes made that it is cheaper for an individual to pay rent than to own his own

home, and figures are adduced to prove it. This is only in line with the fact that you can prove almost anything with figures, but actual experience often discounts the findings of figures; and usually the owning of a home is found to be an asset rather than a liability. Most professional men who have accumulated a competence have owned their homes.

If the American Dental Association had secured a home of its own some time ago, the rent that it has paid would have gone a long way toward helping to pay for the home. The time has now arrived when our Association should begin to think seriously on this matter. The American Medical Association has owned its home for some time, and this is one of the best investments that it has ever made, establishing it in the professional and public mind as nothing else could have done.

Our Association is developing so rapidly that the need for a home is growing more urgent every day. Even with enlarged quarters, we are becoming more crowded all the while, and crowding in an office like ours is not conducive to the best service. When we secured a chemist to investigate the various products that are offered the profession and the public, it was necessary to house him in the chemical laboratory of the American Medical Association, and our organization is under a lasting obligation to the A. M. A. for the courtesy thus extended to us. Without this courtesy, we would have been helpless, because we assuredly have no facilities or space to accommodate a chemist. When the A. M. A. very generously invited our chemist to do this work in their laboratory and placed their facilities at his disposal, they solved this one problem for us at least temporarily; but we cannot remain indefinitely under obligation to them; and as the work expands, more room will be needed. Not only that, but other departments are growing continuously, and if they were not, we would be falling short of the manifest and necessary development of the organization. From every point of view, a permanent home is needed for our Association, and the sooner we begin to plan for it, the better.

The first and natural question to be raised is the possibility of financing such a plan, but this need not make us hesitate a

moment. With the brains in our organization, an enterprise like this can be financed without question. We already have certain assets that might be made available, and then, by strict economy in the management of the Association, it would not take long to pay for a home. The main thing is to begin to plan at once and secure property, vacant or otherwise, before values advance to prohibitive proportions. If a little farsightedness is used, it will be possible to procure property in a locality where values are increasing in such a way as to prove extremely profitable to the Association even as an investment.

We commend this idea to the consideration of our Board of Trustees and our House of Delegates, with the hope that they may think favorably of it and begin to take steps to bring about its consummation. It will mean more for the welfare of the Association than anything that has happened in its history.

MALPRACTICE SUITS AGAINST DENTISTS

The growing prevalence of damage suits against dentists in certain sections of the country should arouse the profession to take a firm and united stand against this species of imposition. Most suits are instigated by designing lawyers whose methods are akin to those of the knave and the crook. It is usually blackmail pure and simple, and while this fact is recognized quite generally by the profession, it is small solace to the poor victim of a dentist when an unjust verdict is rendered against him.

Of course, no reputable dentist will condone criminal carelessness on the part of a practitioner who causes his patient unnecessary injury and suffering, and who wilfully neglects to take the necessary precautions to protect his patient's welfare. It is an unwritten law that the moment a patient takes a dentist's chair, there is not only a professional obligation but a moral one as well to guard in every way possible the best interests of the patient as far as the teeth and mouth are concerned; and a man who thinks carelessly of this obligation and permits harm to come to the patient

through his neglect soon finds himself without the pale of professional respect or recognition.

But the unfortunate thing is that it is rarely this type of man who is sued for malpractice. It is usually the man of ordinary skill and care who is deliberately made the victim of the designs of unprincipled people who are out to wring money from him maliciously. And here is the most significant fact connected with the whole subject: seldom is a suit started, or even the suggestion of a suit, that has not as its background a derogatory remark made to the patient by another dentist. A prominent official of one of our liability insurance companies is responsible for the statement that, back of nearly every suit, there is the circumstance of a disgruntled patient's consulting another practitioner and telling a tale of woe which is listened to with more avidity than it should be, and the seeds are thus planted for a damage suit. If every dentist to whom there comes a dissatisfied patient would take the precaution to relieve the patient's mind, and to emphasize the fact that misadventures are likely to happen with the most careful operator—in other words, to follow the golden rule of treating his fellow practitioner as he would wish to be treated under similar circumstances —it would at once prevent most malpractice suits. Instead, there seems to be the uncontrollable temptation to make professional capital of the misfortune of the former practitioner by playing into the hands of the patient and making him feel that he has been imposed on, and that such a thing would never have happened if he had been in the care of the speaker. It is not necessary to say this in so many words or even to say much of anything. A raising of the eyebrows or a suggestive shrug of the shoulder is enough to sow the seeds of suspicion in the patient's mind, and the damage is done. A little concerted action on the part of members of the profession in their treatment of excitable and unduly wrought patients who come complaining of other dentists would soon wipe out the evil of unjust damage suits, and it is high time that the profession take the proper and legitimate steps for its own protection.

Another individual whose name will soon become anathema in the land unless he mends his ways is the dentist who deliberately

allows himself to be bought to testify against a fellow practitioner. It is easy for an unprincipled lawyer to so quiz a witness of this kind that he can paint the most innocent defendant as a monster of iniquity and incompetency before a jury, and many an unjust verdict has been won in this way. Any man who will besmirch his profession through this means for a few paltry dollars deserves the ostracism of all worthy men, and when it becomes known that he thus alines himself against a reputable defendant, his standing in the profession is gone.

It is not always possible to avoid trouble in this mutable world, but the best precaution a practitioner can take is invariably to be careful in his treatment of every case that comes to him, and to fortify himself with well kept records. If he has established a reputation in the profession and in the community as an honest and capable practitioner and has taken the usual care in his management of cases, this fact will go a long way in influencing a judge or jury in his favor. The law does not demand that a practitioner demonstrate exceptional skill in his treatment of patients, but merely that he exercise care and the ordinary skill of those practicing in the same community that he does. But this much he must do at all times, and any lapse from this is likely to get him into difficulty.

The sentiment of the profession should be cultivated against the injustice of most of these suits, and there should be a bold and well-organized front to combat them. There is nothing more pernicious or heartrending than some of these cases, and the profession must be roused to defend itself. Otherwise, the practice of dentistry will degenerate into an occupation of discomfort and uncertainty, instead of being a source of the most pleasurable service and the most gratifying satisfaction. A professional man should be left free to devote all of his energies to the care of his patients instead of dissipating his substance in the defense of unjust damage suits.

DRUG NAMES AND THE PROFESSION

The organized profession of dentistry rests upon two things: recognition of the supremacy of the interest of the patient and an absolute frankness in the statement of fact. The enemies of the organized dental profession are those who would practice or permit secrecy or untruth to be mixed inextricably with established scientific fact. These are enemies that the organized dental profession must face, especially so in the matter of secret and semi-secret preparations sold to the profession and the public. Many preparations for which exaggerated therapeutic claims are made are sold or distributed to the profession. Frequently, a statement of composition is withheld, so that the profession is given little opportunity to check scientifically the claims made for the product. Or more often, these preparations are sold to the profession under names which are noninforming and nondescriptive of the active ingredients. Oftentimes, what is claimed to be a new compound is put forth, with claims of therapeutic values founded on alleged results, usually without the use of adequate controls or proper comparison with well known drugs, attained by some anonymous or unknown experimenter. This act violates the fundamental principles of dentistry.

The basis of the preceding plea against secrecy is that the *prescriber* must know what he is giving. When a person places himself in the hands of a dentist, the latter is the prescriber, and if not remiss in his duty, he should know the composition of every medicine he uses. Organized dentistry should place itself foursquare against the use of drugs and preparations which are sold under noninforming and nondescriptive names, and the composition of which is undeclared, *quantitatively,* as well as qualitatively. Equally so, he should discourage being importuned to try shotgun prescriptions on this or that man's uncritical recommendation. In this way, the profession as a whole will help clean the Augean stables of materia dentica, and lay the basis for a therapy scientifically and rationally sound. And to this end, the new council which is in the course of formation will be of distinct value in

guiding the profession in matters of materia dentica and in advising the profession concerning the claims made for some products concerning which there may be genuine doubt due to the lack of critical unbiased investigation.

All this is but a further step to the goal of modern dentistry—frankness in statements of fact, so that the interests of the patient may be paramount and may be fully served.

THOMAS A. BROADBENT, B.S., M.S., D.D.S.
(1862-1928)

Thomas A. Broadbent was born at Kewanee, Ill., Sept. 29, 1862. He was educated at Knox College, taking the degree of B.S. in 1885 and of M.S. in 1889. He received the degree of D.D.S. from the Chicago College of Dental Surgery in 1887.

Dr. Broadbent was the secretary of the Chicago Dental Society for three years. In addition, he held membership in the American Dental Association and the Odontographic Society of Chicago. He was a member of the National Board of Dental Examiners, being an ex-president and ex-secretary; president and ex-secretary of the Illinois State Board of Dental Examiners; a member of the Dental Educational Council of America, and of the Delta Sigma Delta Fraternity. He had practiced in Chicago for many years.

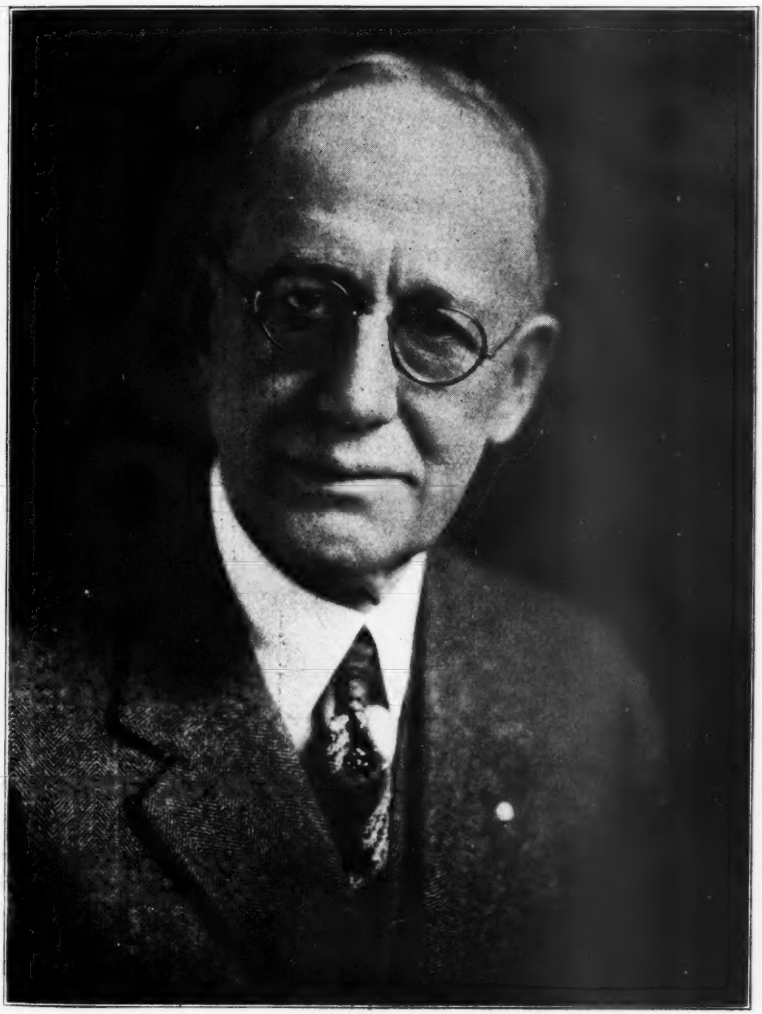
Dr. Broadbent's death, December 29, followed an accident in which he was struck down by a horse driven vehicle near his office at a busy corner in the loop district. He is survived by his widow and three sons, E. Robert, Dr. Donald P., and Grant B.

The following tribute is paid him by one of his many friends:

"In everything Dr. Broadbent did there was an earnestness and a faithfulness to duty that stamped him as one of the conservative and dependable men in the profession. He had been so long engaged in administrative work for the profession, not only on his own state board but also in material affairs, that he had become known as an authority on state board matters, and his advice was sought from one end of the land to the other. His long service as chairman of the tabulating committee of the National Board of Dental Examiners gave him an insight into the necessity for closer cooperation between the dental schools of the country and the boards of examiners, and his influence was always on the side of helpfulness and harmony. He had fewer ulterior motives in carrying out his official duties than most men, and therefore he commanded the universal respect of the profession in an unusual way."

DANA WILLIS FELLOWS, M. D.
(1847-1928)

Dana Willis Fellows, twenty-first president of the Maine Dental Society, was born in Lincoln, Maine, August 14, 1847. He was educated in the public schools of Lincoln, and graduated from Mattanawcook Academy of the same place.



THOMAS A. BROADBENT, B.S., M.S., D.D.S.
(1862-1928)

His professional education was obtained under William B. Bullard, M.D., of Lincoln, followed by a course at the Medical School of Maine at Bowdoin College, from which school he received the degree of M.D. in 1877. Then followed dental instruction and practice under Dr. Thomas Fillebrown in Portland during the years 1877-1881.

Dr. Fellows then associated himself with Dr. Elbridge Bacon at 23 Free Street, Portland, and practiced there from 1881 to 1898. He retired in January, 1920.

He was secretary of the Maine Dental Society from 1878 to 1882 and was elected president of the society in 1886. He was also a member of the following dental societies: Cumberland County (Maine), New England, American Academy of Dental Science, Fillebrown Dental Club and Portland Dental Society. He was also a member of the following medical societies: Cumberland County Medical Association, Maine Medical Association and Maine Academy of Medicine and Science.

Dr. Fellows served for many years as consulting dental surgeon of the Maine Eye and Ear Infirmary, and also of the Maine General Hospital. He also served as lecturer of the School for Nurses of the Maine General Hospital, and as lecturer on dentistry and dental surgery at the Portland School for Medical Instruction. He was a member of the New England Board of Dental Examiners and served a period of time as its president. He was state editor of *Archives of Dentistry* for two years from 1887, and contributed short articles to many dental periodicals.

With Dr. Kelley, he founded the Portland Dental Infirmary in 1897, the first free dental clinic in Maine.

His most noted work for his profession in Maine was his work for dental laws and as a member of the state board of dental examiners.

Dr. Fellows' death occurred December 24, at Port Richmond, N. Y.

GEORGE D. SITHERWOOD

(1844-1929)

George D. Sitherwood, of Bloomington, Ill., was born in Fayette County, Pennsylvania, March 8, 1844. He graduated from a normal school at the age of 18, and the next year enlisted in the Army, serving for four years. He obtained his medical degree from the University of Medicine and Surgery in 1868, practicing in Richfield Springs, N. Y., and Lincoln and Bloomington, Ill., until 1872, when he took up the study of law. In 1875, he entered the office of Dr. John Campbell to study dentistry. In 1877, he opened an office, where he was in active practice up to a week before his death, the result of pneumonia, January 5.

Dr. Sitherwood was a member of the McLean County and the Illinois State Dental societies and the American Dental Association, serving as vice president of the state society in 1919 and as president of the county society several times.

Mrs. Sitherwood and two daughters survive.

BUREAU OF CHEMISTRY

X-IT

A Pyorrhea Remedy

X-IT, "Quick Relief for 'Trench Mouth,'" the X-It Laboratories, 142 E. 32nd St., New York City, is advertised extensively, both to the dental profession and to the public in a typical patent medicine manner.

According to an advertisement in a dental journal, the following statement appears:

> It is our pleasant duty to pass along to members of the dental profession the further expression of hundreds of dentists in the treatment of Vincent's Angina, popularly known as Trench Mouth, with X-It.

In order to determine whether or not X-It was exploited wilfully by the manufacturers as a secret remedy, a letter was sent to the X-It Laboratories, requesting the composition of the product. In reply, the following, from a letter dated September 12, 1928, was received:

> While personally the writer would like to advise your chemist of the composition of "X-It," he is not at liberty to do so at the present time.
>
> However, the ingredients are all well known in medicine, and most of them can be determined from analysis.

It is worth noting, then, that this preparation, in common with other patent medicines, is surrounded by secrecy. The practicing dentist is asked to assume the responsibility in applying a preparation the composition of which is not divulged; an act contrary to the best interest of the patient and to the ethics of dentistry. Do the vendors of X-It expect those unthinking members of the profession who use a preparation the composition of which is unknown to them, possibly to make themselves liable to a poor defense in case of suit for malpractice?

Meanwhile, apparently emboldened by the "further expression of hundreds of dentists in the treatment of Vincent's Angina . . . with X-It," the vendors of the product offered it directly to the public. The following statements are taken from an advertisement which appeared in a large metropolitan newspaper:

> RECEDING GUMS
>
> When gums begin to recede and shrink away from the teeth, look out for trouble. It's one of the first signs of pyorrhea. Be on your guard—use X-It, a healing liquid preparation recommended by over 14,000 dentists and physicians. X-It will correct this and other kinds of gum trouble effectively and quickly.

It is interesting to note the disparity in the number of recommendations: to the profession, "hundreds of dentists"; to the public, "over 14,000 dentists and physicians." But such inconsistencies hardly trouble certain manufacturers. The danger inherent in self medication is well known. Here, the uninformed public are led to believe that pyorrhea can be corrected by self-medication; thus surrounding themselves with that sense

Quick Relief *for* "Trench Mouth"

IT is our pleasant duty to pass along to the members of the dental profession the further expression of hundreds of dentists in the treatment of Vincent's Angina, popularly known as "Trench Mouth," with X-IT.

Many of these dentists say that the results they are obtaining justify them in calling "X-IT" a specific for this rapidly spreading disease. While we hesitate ourselves to make such a broad claim, still we know that X-IT because of its germicidal, stimulating and healing properties, offers a treatment of outstanding value, both for use at the chair and by the patient at home.

We will be glad to submit to any interested member of the dental profession further evidence of the rapid and lasting effect of X-IT in the treatment of Vincent's Angina (and all other gum troubles, including Pyorrhea). The effectiveness of this treatment lies in the fact that X-IT is not only an efficacious germicide, but is also a gum stimulant that restores circulation and promotes healing.

X-IT LABORATORIES, Incorporated

142 East 32nd Street **New York City**

New!

"Dentist's Special" 8 oz. bottle of X-IT for office use, with 6 X-IT gum massagers. Sold direct to dentists only, postage postpaid, $3.00.

For Those Who Have Not Tried X-IT

Instruct your secretary to send us your professional card or letterhead for free samples of X-IT for clinical tests.

Fig. 1.—Advertisement from a current issue of a dental journal.

of false security which would retard them from securing competent advice and treatment.

"X-It" therapy (if such a dignified term may be used) is quite a complicated process. Accompanying each trade package is the "X-It Massage Cup," a small rubber affair for rubbing the substance on the gums, which presumably is part of the propaganda that goes with the "patent medicine." Some of the X-It literature is distinctly novel in character. We learn from a copyrighted circular entitled, "New and Startling Facts About Pyorrhea":

> . . . a formation of tartar often pushes aside the gum and detaches it from the tooth. Here a pocket is formed in which the bacteria of Pyorrhea enter. Breeding here and *distilling their poison* they eat away the connecting tissues of the gum down the sides of the tooth. The tooth structure here is softer, not protected by enamel, therefore cavities form easily. This often leads to abscesses on the sides of the roots of the tooth which discharge their poisons into the blood, affecting all the vital organs, particularly the heart and stomach. [Italics ours.—Ed.]

One naturally wonders if it was modesty on the part of the X-It manufacturers which prevented them from saying that they could condense the distilled poisons and thus solve the mystery of the etiology of pyorrhea. Yet, such is the impression that might be conveyed to the credulous mind.

Vendors of patent medicines always make much of their imagined or self-appointed mission. X-It is apparently no exception. Moreover, the vendors of the preparation are frank in claiming for it a mission. The claim is made:

> It is a liquid *vegetable* preparation worked out specifically for the *prevention* and *treatment* of *pyorrhea* and other germ diseases. It is the product of long and careful scientific and practical research, and has proven most effective in accomplishing its purpose. [Italics ours.—Ed.]

How preposterous! Yet when the X-It manufacturers were given an opportunity to submit evidence for their claims, the envelope of secrecy was pulled over the affair. But such are the methods used, exaggerated and unproven claims shrouded in secrecy and its handmaiden, mystery, which, when exposed to light, are found to be based on some shot-gun mixture of materials which have not been subjected to the crucial test of scientific investigation. The danger, of course, lies in giving a sense of false security to those uninformed enough to use such preparations.

Further claims made are:

> X-It, like the normal saliva, is *alkaline*[1] and hence it counteracts any *acid formation* around the teeth and gums. [Italics ours.—Ed.]
>
> X-It reduces tender, spongy, bleeding gums to healthy, firm and normal texture. It restores dark discolored gums to the pink color of the healthy mouth.
>
> X-It relieves the pain of acute gingival (gum) infection.
>
> X-It reduces septal tissue growth, allays the pericemental pain of malocclusion, reduces chronically inflamed gums so that scaling and polishing can be done with minimum pain and hemorrhage.
>
> X-It when applied to pus pockets by your dentist with a dental syringe positively stops pus formation and consequent tissue destruction.

The profession is naturally interested in knowing something about a product that has worked the wonders claimed for it. As the composition of X-It, "a . . . preparation worked out *specifically* for the *prevention* and *treatment* of pyorrhea . . . [Italics ours.—Ed.] was not given by the manufacturers, the product was submitted to the A. D. A. chemist for examination.

His report follows:

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1. According to recent information, it is generally accepted that saliva is normally slightly acid (see Howell: Text-Book of Physiology, Ed. 10, p. 778, 1927).

TELEPHONE LEXINGTON 2894

X-IT LABORATORIES, INC.

142 EAST 32nd STREET

NEW YORK

Sept. 12th, 1928.

Gentlemen:-

Receipt is acknowledging of your inquiry of September 6th.

While personally the writer would like to advise your chemist of the composition of "X-IT", he is not at liberty to do so at the present time.

However, the ingredients used are all well known in medicine and most of them can be determined from analysis.

Yours very truly,

X-IT LABORATORIES, Inc.

A B Bellwood
President.

ABB/DW

X-IT
is NOT a
MOUTH WASH
or
TOOTH PASTE
★
X-IT
is *effective*
in *treating*
and *preventing*
BLEEDING GUMS
RECEDING GUMS
LOOSE TEETH
and
PYORRHEA
★
Our confidence
in X-IT is
based on *results*
not theory

Fig. 2.—Reproduction of a letter written by the X-It Laboratories.

A. D. A. CHEMIST'S REPORT

"Seven (7) original packages of X-It (X-It Laboratories, 142 E. 32nd St., New York City), price, $1.00 each, were purchased on the open market for examination.

"One (1) package, then six (6) packages were purchased at different times, during the late fall of 1928. Accompanying the single package of X-It was a small circular entitled, 'New and Startling Facts About Pyorrhea,' in which the following statements appeared:

It is a liquid vegetable preparation worked out specifically for the prevention and treatment of pyorrhea and other gum diseases.

RECEDING GUMS

When gums begin to recede and shrink away from the teeth, look out for trouble. It's one of the first signs of pyorrhea. Be on your guard—use X-IT, a healing liquid preparation recommended by over 14,000 dentists and physicians. X-IT will correct this and other kinds of gum trouble effectively and quickly. Pleasant to use, germicidal and safe. Get a bottle of X-IT from your druggist today.

Fig. 3.—Advertisement from a daily newspaper, advertising self-treatment for pyorrhea. To the public, the claim is made, that 14,000 dentists and physicians have "recommended" the product. To the dentists, the claims are a little more constrained, the number of dentists being expressed as "hundreds of dentists."

It is the product of long and careful scientific research. . . .

X-IT, like the normal saliva, is alkaline and hence it counteracts any acid formation around the teeth and gums.

"The six (6) packages purchased at a later date were accompanied by circulars, "How to Use X-It," in which no indication of the composition was given.

"Each bottle contained approximately 35 c.c. of a dark brown liquid, possessing an odor resembling that of oil of wintergreen, mixed with tincture of benzoin. The addition of water caused at first a turbidity, and, after some time, the separation of a resin-like material. The original liquid was acid to moist litmus; the diluted aqueous liquid reacted likewise, contrary to the claim that the liquid is alkaline. The specific gravity at 20 C. was 0.8384.

"Qualitative tests indicated the presence of zinc, chlorid, salicylic acid and emodin-bearing drugs[2] (anthraquinone derivatives), such as may be found in aloes, rhubarb, senna, cascara, buckthorn and chrysarobin, plant products which are frequently used as laxatives. The odor of benzoin combined with the test for emodin-bearing drugs suggests that the genesis of the emodin-bearing material may be compound tincture of benzoin, of which aloes is an ingredient.

"Iron, aluminum and other heavy metals (with the exception of zinc), iron, aluminum, calcium, potassium, sulphur compounds, borate, tannin-like compounds, alkaloids, formaldehyd and hydrogen peroxid were not found.

Quantitative determinations yielded the following:

Alcohol, by volume	87.5 %
Solids on evaporation	2.5 %
Chloroform extract	1.5 %
Ethyl acetate extract	0.3 %
Zinc (Zn^{++})	0.25%
Chlorid (Cl^{-})	0.25%
Salicylic acid	0.05%

"From the foregoing, it may be concluded that X-It is essentially compound tincture of benzoin with a relatively small amount of zinc chlorid dissolved

2. Tincture of myrrh, which is sometimes an ingredient of prescriptions for gingivitis as found in certain formularies, did not respond to the test for emodin-bearing drugs used above.

therein and flavored with oil of wintergreen."

From the Chemist's report, it is little wonder that the manufacturers of X-It were not willing to divulge the formula. The absurdity of the supposed therapeutic claims becomes apparent when we learn from the Chemist's report that the preparation is but an alcoholic solution of benzoin, accompanied by an emodin-bearing drug (probably derived from compound tincture of benzoin) to which a relatively small amount of zinc chlorid has been added. Practicing dentists well know that compound tincture of benzoin mixed with zinc chlorid will not prevent pyorrhea, let alone cure it. Furthermore, it is just such mixtures as this that should be avoided in pyorrhea cases. Its use is similar to sealing up infections before they have received proper surgical treatment. It is little less than criminal, therefore, to foist on the unknowing and unsuspecting public a product which, if anything, will tend to render the duration of the disease longer than if scientific treatment had been used. And finally the statement that it is a "vegetable preparation" when in reality it contains the astringent zinc chlorid is definitely misbranding.

BUREAU OF DENTAL HEALTH EDUCATION

AMERICAN ACADEMY OF PERIODONTOLOGY REPORT OF THE COMMITTEE ON THE HYGIENIST QUESTION

FOR several years, the Academy has received quite lengthy and exhaustive reports on the hygienist question. These reports have elicited little interest and some criticism from the membership. As the present committee has on its list three members who have previously served terms at this task, we have decided to change the character of the report for this reading in an endeavor to present a practical view of the subject, with information which should be of value whether or not a dentist intends to employ a hygienist in his office.

The excellent reports in the past have covered what the hygienist should be and how she should be trained. The present chairman believes that the membership desires to know the situation as presented after a test of about ten years. We shall endeavor to give the actual facts as reported from many sections.

In order that this report should embrace more than the local situations as known by each of the committee, the chairman sent out a questionnaire, which was addressed not particularly to the members, but to several hundred general practitioners in every state. The responses were not so numerous nor so interesting as those sent out at the same time on another subject. The chairman, however, wishes at this time to thank those who could, and did, furnish the committee with information.

It is certainly safe to say that the questionnaires confirm the statement that the members of the Academy are not enthusiastic on the subject of hygienists; nor do they employ the latter to any great extent. The question as to whether this apathy on the subject is right or wrong, and whether the membership is making a mistake in not taking advantage of the service of the hygienist furnishes the incentive to formulate this report by a correlation of facts and statistics on which we may intelligently base decisions in the future.

Question 1. In your state are hygienists employed in the smaller towns?

C. J. Hollister, for the State of Pennsylvania, writes: "Dental hygienists are employed in communities of all sizes in Pennsylvania, from the strictly rural districts with the one room schools up to the cities of large population."

The State of New York: "Dental hygienists are employed by the state oral hygiene committee to visit rural districts in the smaller towns." (T. P. Hyatt.)

In one state, 12 per cent of the registered hygienists are found in small towns, while thirty of my correspondents declare that seldom, or not at all, are hygienists employed by dentists in the smaller towns. The question naturally arises: If they are good for the big city dentists, why not for the small town dentist? As some of our best known and most successful dental practitioners are situated in the smaller towns, our inquiry along this line would be of interest for some future report.

Question 2. Have you heard much criticism of their work being extended into diagnosis or periodontia?

Be it to the honor of the hygienist that, almost without exception, the consensus of opinion from all over the Union is that there was almost no criticism of her work. A few years ago, several papers were published giving instances of gross violations of dental ethics. Since that time, better management by those employing hygienists, and the passage of laws to regulate their field of endeavor, have certainly improved conditions. There were two notable exceptions to the majority:

"I have observed many cases that the hygienists have previously worked on and can state that they do not limit their work to the gingival margin but go beyond this, taking on themselves the instrumentation of the cementum, cleaning deposits from below the gum margin. This is not only encroaching on the field of the periodontist, but is unlawful. I cannot see where it is possible for them to draw the line between oral prophylaxis and periodontia, and do believe they are infringing intentionally, and overstepping the bounds of their privilege. My personal opinion is that there are too many young dentists who have put in their years of hard work to fit themselves to do this work, to have it usurped by the hygienist." (Maxwell M. Dixon.)

"I hear of but few who make any attempt at carrying out any systematic prophylactic treatment for their patients." (Gillette Hayden.)

Question 3. Invite yourself into some office where hygienists have worked for several years and examine some patients who have had regular treatments for some time. Report any harm to patients that these treatments by hygienists have done.

"The only harm noted was the result, not of what hygienist did, but of what dentists did *not* do, by delegating to her the examination of cases and placing too much responsibility on her. I have seen cases of advanced deep pockets overlooked which might have been prevented if the dentists had kept close watch on cases that his hygienist was doing prophylactic work for." (Celia Rich.)

"I have been in many offices where hygienists are employed. I have observed no harm that they have done, but noted some neglect and incompetence." (T. F. Bates.)

"I have never noticed any case where harm has been done." (Drs. Bricker, Charters, Cross, Hollister, E. M. Quinby, H. J. Leonard, C. H. Schott and F. H. Skinner.

This evidence of good results coming from so many sections, and from men of known integrity and reputation, seems to outweigh any personal feeling one may have. The hygienist seems, on this question, to have won an overwhelming decision in her favor.

"Those employing dental hygienists in Pennsylvania seem well satisfied." (C. J. Hollister.)

"Properly trained hygienists are, in my opinion, an essential in every well regulated office." (Claude Hughes.)

If all hygienists were like the ones referred to in the following paragraph this report would be unnecessary.

"It was necessary to invite myself into the dental clinic of the Metropolitan Life Insurance Company, where we have had dental hygienists working ever since 1917. As we handle several thousand of cases every month, in the course of these years we have handled a great many thousands of cases and have yet to find

one case where harm has been done to the patient. On the other hand, there have been a number of cases in which the patient believed that the dental hygienist had pulled out a filling with a fine pointed explorer, and it has been hard to explain to the patient that such fillings are better out than in the mouth." (T. P. Hyatt.)

Question 4. What is the average yearly income of hygienists in your section?

The minimum amount declared was $100 per month, while the maximum was $4,000 a year. All the hygienists interviewed state that they hope to attain the maximum income before they die. The committee hopes that they will prove themselves worth it.

Question 5. Are the younger dentists who are not able to employ hygienists doing much systematic prophylactic work, and is their work better for this reason?

"Prophylaxis is neglected unless the hygienist is employed." (Claude Hughes.)

On the other hand, Hardaway says: "I find that recent graduates of dentistry are doing better scaling and prophylactic work than are the older men." Now it must be borne in mind that this opinion comes from Kentucky where they do not license hygienists. It is suggested that some investigator report whether this holds true for every state where the hygienist does not practice.

"I believe that a great many of the younger dentists do more systematic prophylactic work than in the years gone by, and undoubtedly, as a result, they are doing better operative work." (T. P. Hyatt.)

With the single exception of the foregoing statement, all seem positive that the younger men are neglecting this important branch of work. The field is left wide open for the hygienist, because the dentists, as a general rule, are not doing prophylactic work. If the younger men for the last ten years had been awake to the situation and answered the call of preventive dentistry, the hygienists would not have so successfully swept the field.

Without reflection on the success of the hygienist, it is to be hoped that some day there will result such a reaction that our colleges can impress on their graduates the real worth of preventive dentistry, and that much of their skill will be exerted in this direction. Certainly, no one will deny that the patient will be better off; and the office which can employ only graduate dentists, whether men or women, to practice prophylaxis is to be congratulated. But they are so few and far between as to be the exception to the rule.

Question 6. Inquire as to whether any dentists have dispensed with the services of hygienists in your section and for what reason.

This question was important in that it gave those who looked with disfavor on the hygienists an opportunity to discredit the success of their work. Marriage was the only thing that broke their office connection. Not one single instance was reported in which the dentist was willing to do without her service.

Questions 7 and 8. How many dentists are employed in your school system? What is their standing as compared with regular teachers? Does the work extend to teaching the educational factors of oral hygiene?

On this question, several of the committee would like to write the entire report. Merely a few high-lights on the subject will be given.

"In Shelbyville, Tenn., the primary

teachers teach oral hygiene." (T. F. Bates.)

"In California, sixty hygienists are employed by schools, teaching only in most places as time does not allow for prophylaxis." (F. A. Bricker.)

"The hygienist primarily does work at the chair in Cleveland and Dayton. In Cincinnati, more educational work is done and, in Franklin county, it is practically all educational." (Gillette Hayden.)

"In Pennsylvania, there are about 120 dental hygienists who have an equal status with regular teachers; consequently, much educational work is carried on." (C. J. Hollister.)

"The state department of public health employs fifty girls. This figure includes dental hygienists employed by the department of education and other agencies. They are not ranked as teachers but as health workers, much the same as school nurses. State authorities are anxious that dental hygienists should have more training in teaching principles. They do not believe the dental hygienist should teach in class rooms, but recommend that dental hygienists supervise community school dental programs, giving school teachers the material to be taught to children. This is the opinion of the American Child Health Association, I believe." (E. M. Quinby.)

"In New York City, the department of health employes more than twenty-five hygienists, who have no such status as a regular school teacher. The department of health used to look after the educational features, but this has been delegated to the oral hygiene committee." (T. P. Hyatt.)

The Georgia Board of Health has just employed one hygienist, who is attached to the healthmobile. She only teaches. And so the matter ranges throughout the entire Union. At this part of the report, we quote the views of a member of the committee, Dr. Hardaway: "Kentucky does not license hygienists, therefore, we have none, not even in our public school work. This is all done by the graduate dentists, men."

Still another member of the committee, Dr. Leonard, furnishes this interesting opinion: "The dental hygienist has an extremely useful function which can very largely solve our problem of preventive dentistry. This function is the examination of the teeth of the children in the schools and the education in dental hygiene of those children by all educational means possible. The work done is yielding the most effective results for the money spent of all work done anywhere in preventive dentistry."

"Attempting to clean the teeth of the children in schools with the very haphazard and not very effective educational work that goes with it, I think is a waste of time and money. I am not particularly enthusiastic either about the work of the dental hygienist in private dental offices. If that were the only function which they could perform, I am not sure that I would think that they do more good than harm. I would certainly not be working hard for dental hygienists as prophylactic technicians in dental offices." (H. J. Leonard.)

Question 9. What is the most important requirement of your dental law for hygienists? What is its greatest fault?

Question 10. Have you heard of any infractions of your law through hygienists being punished?

The question of dental laws governing hygienists is too great a subject for mention in our already too lengthy report. This is to be taken up at one of the round table discussions and we sug-

gest that the committee next year report in full on this phase of the subject.

Question 11. What is the general sentiment in your section as to the present situation regarding the work of hygienists?

We are indebted to Lewis Ottofy, editor of Polk's Dental Directory, for the following data. Under date of July 13, part of his letter reads: "I have had copied for you from what I have, just as it stands today, with the material so far. In the list, you notice that some of the lists of graduates are complete from the time the schools were organized, up to date. But that from three important schools, Rochester, Pennsylvania, and Michigan, these reports are incomplete. I estimate the probable number from these schools to be 600, and that added to the 1,775 would make it appear that 2,375 have been graduated.

"From the state lists, you will see that from most of them I have complete returns. But here, too, from some important states such as Pennsylvania and Ohio, I have not yet received reports. In Pennsylvania, the number is large, and I estimate that if I could get the complete figures, there would be 200 added to the 2,139, making it appear that 2,339 are registered in the various states. While this is not complete, it is safe to assume that there must be about 2,400 dental hygienists. The increase from year to year could only be secured by corresponding with each school which teaches dental hygiene, as I have from most of them only an alphabetical list of all graduates, without giving the year of graduation."

To those who appreciate figures and wish to speculate on the future of this hygienist question, the foregoing statistics will be of special value.[1]

1. Compiled by Louis Ottofy, Chicago, Ill.

NUMBER OF GRADUATES OF SCHOOLS OF DENTAL HYGIENE.

From the time of their organization to August 1, 1928.

California	
University of California	56
Colorado	
University of Denver (discontinued)	17
Connecticut	
Fones School of Dental Hygiene (discontinued)	84
Georgia	
Atlanta School of Oral Hygiene (Opened Oct. 1, 1928)	0
Hawaii	
Training School for Dental Hygienists	25
Illinois	
Northwestern University	76
Massachusetts	
Forsyth-Tufts Training School for Dental Hygienists	584
Michigan	
University of Michigan	96
Minnesota	
University of Minnesota	78
New York	
Columbia University	547
School for Dental Hygienists, Rochester	624
Pennsylvania	
University of Pennsylvania	239
Temple University	57
Wisconsin	
Marquette University	85
	2,568

DENTAL HYGIENISTS REGISTERED IN THE STATES.

To August 1, 1928, except where otherwise stated.

Alabama	10
Arkansas (law provides for dental hygienists)	0
California	64
Colorado	52
Connecticut	342
District of Columbia	28
Florida	30
Georgia	51
Hawaii	25
Iowa	21
Louisiana (New law in effect, July 16, 1928)	1
Maine (To September 30, 1927)	18
Massachusetts	499
Michigan	105
Minnesota	208

Mississippi	4
New Hampshire	22
New York	549
Ohio	37
Oklahoma (To July 1, 1927)	6
Pennsylvania	123
South Carolina	7
Tennessee	17
Vermont	6
Washington	51
West Virginia	17
Wisconsin (To November 30, 1927)	94
Wyoming	1
	2,389

Certainly, it is no speculation to forecast the statement that the hygienist is here to stay. She is not and never will be in competition with members of this Academy. Knowing as we do the importance of preventive dentistry and the skill necessary to teach and practice this specialty, we will do all in our power at every opportunity to insist on a more complete education of these women.

Respectfully submitted,

Frederick A. Bricker,
Harold DeW. Cross
A. M. Hardaway
Harold J. Leonard
Robin Adair, *Chairman*

803 Atlanta Nat. Bank Bldg.,
Atlanta, Ga.

PREVENTIVE DENTISTRY

By FREDERICK A. BRICKER, D.D.S., Hollywood, Calif.

WHAT do we mean by preventive dentistry? We mean the prevention of mouth diseases so that we do not have to resort to restorative dentistry such as fillings, bridges, extractions and false teeth.

How can these conditions be prevented? By giving intelligent care to the teeth and mouth, by eating the proper foods, which will prevent 80 per cent or more decay of the teeth, tartar or deposits on the teeth, pyorrhea and many systemic diseases attributed to unclean and uncared for mouths.

What is an unclean mouth? One that retains decayed teeth, deposits or tartar on the teeth and diseased roots of teeth; a film on the necks of teeth that forms the best breeding field for germs that we can give them; loose teeth, pyorrhea, inflamed and bleeding gums. Any mouth that is not given intelligent care is unclean.

Bacteria are starved by cleaning the mouth, and the tissues are fed by stimulating circulation.

What Causes Decay.—Decay is caused by allowing a film, or what we call a bacterial plaque, to remain on the teeth a sufficient length of time to ferment. When this film ferments, it forms an acid and it is this acid that disintegrates the enamel and forms a cavity.

You can detect this film on the teeth by drying the teeth and gums and applying tincture of iodin with a pledget of cotton wrapped on the end of a toothpick. The film will stain brown and only the film will take the stain.

What Causes Tartar.—Tartar or deposits on the teeth are caused by this same film.

Just what is this film on the teeth? It is a mixture of food, saliva, calcium salts deposited from the saliva and debris in general that gathers in the mouth. As you know, in every mixture, the heavy parts settle to the bottom; so it is with this film mixture on the teeth. This is sealed or held to the teeth by the mucin or that sticky part of the saliva, and we call it tartar.

What Causes Pyorrhea.—Pyorrhea is caused by any condition that will cause an irritation of the tissues around the roots of the teeth: this film, mentioned before, tartar, loss of teeth, improperly placed restorations and, above all, lack of intelligent care.

The mouth is the port of entry for all that sustains life. But, unfortunately, no passports are required. All classes of immigrants are welcome, and those which destroy life are just as free to enter as those which sustain it.

The unclean mouth is, then, nothing other than a mixing chamber lined with 30 square inches of most virulent germs, foul pus and decaying food, all maintained at the best temperature for the production of germ life.

It is easy to see the result of permitting such a condition to persist, and yet this condition, revolting as it seems, exists in the majority of mouths.

The relationship of dentistry to general health is assuming such a commanding position that you and I enlighten ourselves on this subject, if we wish to prevent many of the systemic diseases that are attributed to unclean and uncared for mouths. Why are we making such an ado about unclean mouths? Because the vast numbers of unclean, germ-generating mouths have become a serious health problem. Because periodontal diseases (pyorrhea) and pulpless teeth, according to many dental and medical authorities, are causing more systemic infection than any other single factor.

Do you realize that an unclean mouth is the predisposing cause of such diseases as anemia, arthritis, nephritis, iritis, cystitis, myocarditis, appendicitis, encephalitis, gastritis and gastro-intestinal and duodenal ulcers? And last, but not least, an unclean mouth in its reaction on the stomach is a predisposing cause of that irritable, touchy, peevish disposition which you find in so many individuals.

As far as dentistry is concerned, it is now generally conceded that there are three factors, indifference, ignorance and neglect, that are largely responsible for the present prevalence of dental diseases.

There are many diseases of mankind. We are created with weakness or lack of natural immunity, and where this weakness exists, we may be attacked by numerous diseases from birth to old age. Pyorrhea and decay are no exception.

Ninety-seven per cent of all decay takes place on one or two of three or all three surfaces of a tooth. They are the surfaces of a tooth that you fail to clean with the toothbrush, including fissures and pits on the chewing surfaces, the surface between the teeth and around the gum margin. These are the locations of most of the tartar also. Visualize the surfaces that include the fissures and see that you clean these surfaces if you wish to prevent the greater amount of decay.

Eighty per cent or more of pyorrhea begins in the gums between the teeth, because the gums between the teeth receive less stimulation than any other part of the mouth. Therefore, work the bristles of the brush between the teeth so as to stimulate or exercise the gums if you wish to prevent pyorrhea.

Brush the whole mouth, gums, roof of the mouth, teeth and tongue. Work on the foundation that good circulation in any part of the body is the definition of health.

Here are a few facts about mouths to be remembered, and if you will practice them and pass them on to your friends, the day of healthier mouths will be well on its way.

1. Health is dependent on scrupulous cleanliness of the mouth in which circulation is kept active through intelligent stimulation with a brush.

2. Periodontoclasia (pyorrhea) is not a specific germ disease such as typhoid, diphtheria, pneumonia germs, etc. It is not contagious.

3. Periodontoclasia can be prevented and cured by proper hygiene, diet and regular visits to the dentist so that he may recognize the early signs and symptoms and correct them.

4. An unclean mouth and disease of every variety go hand in hand.

5. The mouth will not remain healthy without care, and although the dentist can assist Nature in rebuilding, ultimate recovery depends on the cooperation of the patient.

6. The mouth is the seat of more focal infection than any other part of the body and its available area for infection is greater.

7. There are no drugs that will cure pyorrhea. We must remove the cause, maintain a clean mouth and stimulate circulation in the tissues around the roots of the teeth by intelligent use of the toothbrush.

CURRENT LITERATURE

EXTRACTS AND ABSTRACTS

Cancer of the Face: Of the various therapeutic methods of handling cases of cancer, at the present time surgery and irradiation, either by radium or the roentgen ray, are proving most successful, according to Willy Meyer (*Am. J. Surg.*, October, 1928). A technic employing the scapel is, in operable cases, the safest method, although the galvanocautery, endotherm knife, electrocoagulation, electrodessication and the actual cautery may be used in certain cases for the destruction or removal of the lesion. The two main classes of face cancer are the squamous cell epithelioma and the basal cell epithelioma, commonly called the rodent ulcer. The former metastasizes, the latter tends to remain localized, but destroys the adjacent cells as it grows and spreads. (The latter only is dealt with here.) Its total destruction should eliminate the condition. A very small skin epithelioma might be cured by curettage, the use of radium or the roentgen ray or by the various electrical currents, but actual destruction by the galvanocautery is the surest and quickest method. This holds good for lesions lying over soft tissue, but those above cartilage or bone are more difficult, recurrences frequently following irradiation of the growth, because all of the cells are not destroyed. Therefore, that method is safest and surest which will destroy the lesion. In the larger lesions in which the galvanocautery cannot be used, surgery is the chief or only recourse. Each case must be carefully planned, safe lines of section being decided on and the resulting defect being visualized. The reconstruction work that must follow is kept well in mind in planning the operation. Care must be exercised to prevent implantation of cancer cells during operation. Colonic anesthesia is the choice if local anesthesia is impossible. A case is reported, with illustrations and diagrams, in which there was recurrence after two erythema doses of the roentgen ray had apparently resulted

in healing. The original lesions involved the left portion of the upper lip, the cheek, the ala of the nose and a portion of the floor of the nose. The recurring lesions were at the angle of the nose and near the outer periphery. Under irradiation, the condition showed a tendency to spread. Therefore, surgery was resorted to, under colonic anesthesia, the surgeon being thus unhampered by the anesthetist's apparatus. A post nasal plug was inserted, and the surface of the lesion was cauterized and carbonized to prevent smearing and implantation of cancer cells. Instruments used on the tumor side of the lesion were never used on the tissue side, and hemostats were not replaced without resterilization. Convalescence was uneventful, and cosmetic results were satisfactory after two operations. Regarding the specimen submitted to the pathologist, the author says: "The specimen was carefully marked with various black silk threads at the time of operation . . . so that, with the diagram, the pathologist might recognize, orient and understand the specimen. Thus he could give an intelligent report not only as to the pathology of the lesion but also as to its extent and the safety of excision. Only in this way can a fair prognosis be determined." The patient is entirely symptom-free eighteen months after removal of the growth.

Fees: The medical profession has come in for many opprobrious remarks on account of the charges made for services. No attempt, however, seems to have been made to analyze the question to see whether the complaints have been just or not. That some of the charges may have been exorbitant there can be no question, but that such has been the rule must be denied. Nor is the profession entirely to blame if the fees have been raised in certain cases. The people have gotten away, as has been shown, from the custom of consulting their family physician in ordinary illnesses. They seem to have developed the idea that there must be a specialist for every ill, and that they must have as many physicians or specialists as they may imagine that they have diseases. It is no wonder, then, that the profession should yield to the demand of the people and provide so-called specialists to meet their every whim. Of course, the people expect to pay the specialist more, and if he doesn't charge more it is thought that he cannot be much of a specialist and they are dissatisfied. It must be acknowledged that this has given rise to a certain amount of commercialism in the profession which is to be greatly deplored; but it must be admitted that many physicians act just like other human beings. Here is a sort of vicious circle: the people look for specialization; the medical schools turn out more specialists; specialists, being poorly versed in general medical knowledge, become narrow minded and see nothing but their particular subject in the patient, overlooking the fact that a human being is not simply a group of disconnected functions, but a harmonious combination of many interrelated functions. —M. L. Harris, in *J. A. M. A.*, Dec. 1, 1928.

Oral Sepsis and Mental Disorder: According to Thomas Beaton (*Dent. Surgeon*, Oct. 13, 1928) marked impairment of the general health is always associated with mental disorders some time during the course of the latter. At least, the vitality of the patient is reduced and there are clinical manifestations such as one would expect to find in association with some form of chronic toxemia. In confusional insanities, it is often necessary to adopt vigorous measures to improve the associated bodily conditions, in order to save the patient's life. In some states, the mental condition so overshadows the physical that slight disturbances of the latter are overlooked, and in the lesser mental maladies, such physical debility as exists is often considered a result of the mental perturbation. Whatever the situation, attention to the physical side of the patient's condition has come to be regarded as imperative. When no gross manifestations of physical debility have been found, search for a septic focus which may be undermining the patient's resistance and thereby affecting his mental state is made. As regards oral sepsis, while it must not be regarded as the dominating factor in the etiology of a mental disorder, neither should be disregarded. Obviously, an unclean mouth should be cleaned up; and in many cases, improvement has been notable not only in the physical health but also in the mental state. In more latent conditions, and when the patient insists on extensive extractions, the surgeon must be convinced that this is really necessary, as after operation the patient may become more depressed than ever in his efforts to adjust himself to the new condition of his mouth. Certainly, in cases of extreme nervousness,

all radical measures should be postponed until the condition is more stable. In some cases, operative interference may be the last straw to a patient verging on a definite insane state. The mental patient must be gently handled, and any measures, especially if at all radical, must be carried out in successive stages. A mental condition of long standing is not likely to be benefited by operative interference, but a disturbance of recent origin may often be improved by removal of septic oral conditions. A general anesthetic is often best for the frankly insane, because of his possible objection to the operation; while for the highly strung patient, a local anesthetic is advisable, both from the standpoint of the patient and from the technical aspect of the case.

Osteomyelitis of the Jaw in Scarlet Fever: At the Royal Society of Medicine, Mr. T. B. Layton described two cases of osteomyelitis of the jaw in scarlet fever, which led to a very important discussion. The paper by H. F. Mantell in the official Reports of the Metropolitan Asylums Board (which controls all the fever hospitals of London) was quoted. In 1897, he described nineteen cases of necrosis of the jaw in a series of 12,230 cases of scarlet fever. In sixteen of these there was a common factor determining the necrosis, viz., mechanical injury. The throat and mouth were, of necessity, frequently cleansed and food was given at frequent intervals. The patient actively resisted this treatment. The necrosis began in the height of the acute stage, close to the symphysis of the lower jaw. Seven of the sixteen patients died. In only three was the upper jaw involved and of these two recovered. In those days syringing the throat was a common method of treatment, and to do this the gag was frequently needed in a recelcitrant child. Of the three other cases, one was a case of general ulcerative stomatitis occurring in the fourth week and ending in death. The two others were associated with alveolar abscesses around a carious tooth and were therefore probably analogous to those described by Mr. Layton. In one, the maxillary sinus was involved.—London letter, *J. A. M. A.*, Oct. 6, 1928.

Danger from Mercury and from Amalgam Dental Fillings: The danger of copper is now, Stock says *(Med. Klin.)*, fully admitted. Silver amalgam is much less injurious, but mercury poisoning from silver amalgam dental fillings has been demonstrated beyond doubt in a considerable number of cases. It is often possible to demonstrate mercury in the stool when it cannot be detected in the urine; also the excretion of mercury varies widely, so that it may be present on one analysis and absent on another. He warns from his personal experience that even gold fillings may contain mercury in amounts sufficient to cause symptoms.—Abstr. *J. A. M. A.*, Oct. 6, 1928.

Fire and Explosion Hazard in Anesthesia: Rebreathing is an essential feature in prevention of explosions in the administration of ethylene-oxygen, and nitrous oxid-oxygen-ether anesthesia, the gases being rendered inexplosive by the addition of moisture and carbon dioxid that is exhaled from the lungs. Ethylene and oxygen being permitted to flow together through an apparatus are potential danger of sufficient static production to ignite these gases in a fresh, unbreathed, normal state, and fractional rebreathing by exhaling a portion of each breath into the room greatly adds to the menace of it becoming ignited by electric sparks, cautery and so forth. Grounding the apparatus is uncertain in dealing with static and grounding the patient is particularly dangerous should the grounding connections of the apparatus fail, and also exposes the patient to the danger of serious injury from coming in contact with the house current through electric lights or other electrical devices, such as cystoscopes and bronchoscopes. Ethylene is not an office anesthetic, as the modern office has too many electrical devices, and furthermore it is most suited to major operations that demand hospitalization, and in the hospital also it can be more properly safeguarded by the use of fans when the cautery is to be used. Ether should not be used with oxygen by insufflation, and within the closed method should be safeguarded the same as ethylene from becoming ignited. The use of the cautery, fulgurator and so forth about the head, face and neck requiring more than momentary application requires complete ether anesthesia, followed by its complete removal before using these applications, and if the anesthesia must be prolonged, chloroform should be used.—J. G. Poe, in *Cur. Res. Anes. & Anal.*, September-October, 1928.

FOREIGN LITERATURE

Histology (Harry Sicher, Fortschr. d. Zahnheilk., No. 4, 1928, p. 255): The author briefly reviews the normal histology of the pulp. This is followed by a discussion of the periodontium. With a series of very fine photomicrographs, he shows the direction of the peridental fibers at the different levels of the root. The illustrations show clearly that the peridental fibers become imbedded in new bone deposited on the "pull side" of the moving teeth. This observation was first made by Stein and Weinmann. The author denies the existence of a circular ligament but affirms the existence of a very strong interdental ligament. This ligament (a strong group of fibers) is found regularly between neighboring teeth just above the alveolar crest. It persists even though teeth are separated through wandering. It disappears only after extraction.

EMIL MUELLER, CHICAGO

Dental Metallurgy (Friedrich Schoenbeck, Fortschr. d. Zahnheilk., No. 10, 1928, p. 906): The author confines himself to a study of solders. After a brief discussion of composition and characteristics, he shows microscopic pictures of solder undergoing slow and rapid crystallization. Tests were made with solders as well as with gold plates of different carats. Two specimens of identical materials were used for each test, one being cooled rapidly, while the other was cooled slowly. In every instance, slow cooling showed homogeneous crystallization, while rapid cooling showed heterogeneous crystallization.

EMIL MUELLER, CHICAGO

Industrial Diseases of the Oral Cavity (Julius Misch, Fortschr. d. Zahnheilk., No. 8, 1928, p. 699): More physicians are employed by industrial organizations in America than in Germany or in any other country. Their sphere of activity in America also extends much farther. The duties of physicians in industry are chiefly to guard the health of, and teach hygiene to, those employed. It is largely in America that dentists have found a place in industrial establishments. Because early symptoms of industrial diseases are frequently to be found in the mouth, it is highly desirable to have the cooperation of the dentist to aid in the early diagnosis of same. Of industrial diseases, by far the most common is lead poisoning, which accounts for 88 per cent of all industrial diseases. Another common poisoning is caused by mercury. Early symptoms of mercury as well as lead poisoning are found in the oral mucous membrane. Profuse flow of saliva is also an early symptom, and in some cases extreme dryness of the mucous membrane has been observed. Bismuth poisoning is not uncommon in industry. Bismuth used in the form of pastes as medicaments in root fillings, in sinuses and cysts have not uncommonly produced intoxications. Poisoning from benzin are also quite numerous. Poisoning from zinc, manganese, hydrofluoric acid and phosphorus are still common. These affect quite readily the bony support of the teeth, consequently causing a loosening. Injuries from roentgen rays and radioactive substances have been very numerous of late. An extensive bibliography is appended to the article.

EMIL MUELLER, CHICAGO

Jaw Resection, Plastic and Prosthetic Treatment (Hans Pichler, Fortschr. d. Zahnheilk., No. 11, 1928, p. 1001): Wherever possible, every case of extensive resection should be followed by autoplastic surgery. Plastic surgery is so successful today that provisions for it should be made during the primary operation. Temporary as well as permanent prosthetic appliances are frequently useful for maintaining the bone fragments and tissues in a favorable condition for future operations. The author describes an appliance that he used in the case of a unilateral resection of the mandible following sarcoma. It is particularly interesting to note that he believes in the immediate construction of appliances to prevent distortions through shrinkage of tissues, largely due to lack of function. He describes a method for resection of upper jaws in cases of extensive swelling. The whole cheek is folded upward, the cut being made in the submaxilliary region. An illustration of an appliance by H. Wolf, called the "gnathatom" is given. This is claimed to be very effective in the removal of large bone masses, because it cuts sharply, and little bleeding and no necrosis follows. In cases in which tissues under prosthetic appliances are denuded and the epithelization is slow, the author enlarges the appliance by relining it with compound, allowing it to extend well in all directions. A piece of epithelium from some other portion of the

body is obtained and placed against the compound so that, when the appliance is again placed in the mouth, this new epithelium is brought in contact with the denuded portion. This is maintained in place for several days, until union is obtained. The compound is then gradually removed. The article is illustrated with many roentgenograms and drawings of practical cases of fractures. These are extensively discussed. Those interested in plastic surgery will find many things of value in this treatise.

EMIL MUELLER, CHICAGO

Bacteriologic Studies of Devitalized Pulps (Willy Hoch, Vierteljahrsschr. f. Zahnheilk., Vol. 44, No. 3, 1928): With the most painstaking surgical cleanliness, sixty-six pulps, presumably all infected, since they were all either actually or almost exposed by caries, were devitalized with arsenic or cobalt, removed after forty-eight hours and studied histologically, chemically and bacteriologically. All were found to be perfectly necrosed (as is desired in pulp extirpation) and, at the same time, free from the chemical corrosive agent employed, as well as from all bacteria. The author concludes, on this basis, that any residual pulp tissue remaining in the teeth so treated must consequently be safe, and, if covered with a mummifying paste, should remain sterile and benign indefinitely.

JAMES D. FRANKEL, CHICAGO

Examination of the Hardness of the Enamel (Proell and Schubert, Zeitschr. f. Stomatol., 1928, No. 11, p. 1047): The authors constructed an apparatus with which they could measure the hardness of the different tooth structures. Enamel showed the hardness of apatite, which was greater in degree toward the surface and becomes greater with age. In cases of pyorrhea, the enamel was found to be harder than in normal cases. The greater hardness toward the surface, the authors explained to be due to calcification during life. They ground the teeth of dogs and found the dentin to be harder on the side adjacent to the grinding. The enamel did not show any difference in hardness.

BALINT ORBAN, CHICAGO

The Question of Root Amputation (Rudolf Kronfeld, Zeitschr. f. Stomatol., 1928, No. 11, p. 1105): Histologic examination of the root of a lower second bicuspid on which a root amputation had been performed the previous year because of chronic periodontitis showed new deposition of cementum only on the cross-section of the cementum. Corresponding to the cross-section of the dentin, a marked inflammatory epithelial proliferation was found. The dentin itself showed neither apposition nor absorption, the symptoms of inflammation becoming more intense from the periphery toward the center. Since the root canal was free from organic detritus, the inflammation must be traced to a gangrenous condition of the dentin. It must be pointed out for practical work that filling of the root canal alone during operation does not suffice to check further inflammation and infection of the area, for either can develop from the cross-section of infected dentin. In some way, one should try to make this infected dentin harmless.

BALINT ORBAN, CHICAGO

MISCELLANY

BOOK REVIEWS

Dental Jurisprudence, An Epitome of the Law of Dentistry and Dental Surgery. By Elmer D. Brothers, B.S., L.L.B., Professor of Medical and Dental Jurisprudence in the University of Illinois, and lecturer in John Marshall Law School, Chicago. Second edition; 246 pages; price, $2.25. Published by The C. V. Mosby Company, St. Louis, Mo.

This is a subject that should claim the attention of every dental practitioner as well as every student. The growing prevalence of malpractice suits in dentistry in certain sections renders it important for every practitioner to make himself familiar with the regulations that govern the legal conduct of a practice. It is an old established principle that "ignorance of the law excuses no man," and it behooves dentists to familiarize themselves with their rights as well as their legal obligations. We commend a study of this book to the attention of the profession.

Table Talks on Dentistry. By Rodriques Ottolengui, M.D.S., D.D.S., L.L.D., F.A.C.D., author of the textbook, "Methods of Filling Teeth," and editor of *Dental Items of Interest.* 488 pages; price, $7.00. Published by Dental Items of Interest Publishing Company, Brooklyn, New York.

Dr. Ottolengui always writes most entertainingly on any topic, and in these "Table Talks" he is really at his best. A book compiled in this way does not lend itself to a detailed review on account of the variety of topics treated and the informal manner of their presentation, but it is safe to say that it will be read more generally than would a book written in the ordinary stereotyped manner, and treated in a formal way. There is a spontaneity in the presentation of the various subjects that is really refreshing, and we have not found a dull page in it.

The Normal and Pathological Physiology of Bone—Its Problems. By R. Leriche, Professor de Clinique Chirurgicale a la Faculte de Strasbourg, and A. Policard, Professor d'Histologie a la Faculte de Lyon. Authorized English translation by Sherwood Moore, M.D., Professor of Radiology, Washington University School of Medicine, and J. Albert Key, M.D., Assistant Professor of Clinical Orthopedic Surgery, Washington University School of Medicine. Illustrated; 236 pages; price, $5.00. Published by The C. V. Mosby Company, St. Louis, Mo.

It is well that an English translation of this book has been made. Anything that will add to the knowledge of bone on the part of physicians and dentists should be welcomed, and this book has evidently been prepared with much care.

It will, of course, appeal more to medical men than to dentists, and yet the latter will find much of value in it. Any book that adds to the breadth of vision of the dentist is commendable, and a reference to this book will well repay any dentist for his trouble. The volume is carefully prepared and the mechanical makeup by the publisher is most commendable.

Polk's Dental Register and Directory of the United States and Canada. Thirty-fourth year. Fourteenth edition, 1928. Embracing a list of dentists arranged by cities, states and provinces, giving year and college of graduation. Population of places where dentists are practicing. Complete list of all existing and extinct dental colleges in the United States, Philippines and Canada. Code of Ethics of the American Dental Association. List of international, national, state, interstate and local dental associations. Full text of laws governing the practice of dentistry in the United States, possessions and the Dominion of Canada. Information relating to dental practice in all parts of the world. Reciprocity regulations. Personnel of the Army, Navy, Public Health Service and Veterans' Bureau of the United States. List of dental journals in the United States and Canada, with rates of subscription, name of publisher, editor and period of publication. List of all dental periodicals printed in English. List of important dental books. List of dental clinics in schools, industrial establishments, hospitals, etc. A complete list of students who graduated in 1928. A section relating to dental hygiene, with a list of dental hygienists. Other information of interest to the dentist. An educational guide pertaining to colleges, schools and books. A buyers' guide embracing the leading dental manufacturers and dealers, and a classified business directory indicating where articles used by dentists may be secured, and a complete index of dentists, alphabetically arranged. Price, $25.00.

Polk's Directory is so well known that comment is unnecessary. The book has become indispensable to all of those who have occasion to communicate in any way with the profession, and it still remains the standard. The 1928 edition has been brought well up to date, and it seems to be in every way satisfactory.

THE FEBRUARY FRONTISPIECE

The frontispiece for this, the February issue, of THE JOURNAL, is a group photograph of the Past Presidents of the American Dental Association who were in attendance at the Annual Session in Minneapolis. Reading from left to right, they are: top row: Henry L. Banzhaf, Mark L. Finley, Lafayette L. Barber, Homer C. Brown, C. Victor Vignes, H. E. Friesell, Sheppard W. Foster; center: J. D. Patterson, F. O. Hetrick, Donald MacKay Gallie, Thomas P. Hinman, C. N. Johnson, William A. Giffen, Harvey J. Burkhart; bottom row: John P. Buckley, Thomas B. Hartzell, Roscoe H. Volland, John V. Conzett, William H. G. Logan. All but two of the living Past Presidents were in attendance at this meeting.

NEWS

Dr. Feltus on National Examining Board: H. J. Feltus, of Baton Rouge, La., has been appointed by the Board of Trustees of the American Dental Association to fill the vacancy on the National Board of Dental Examiners occasioned by the death of Thomas A. Broadbent.

Resolution Regarding Tooth Paste Advertising: The following resolution was adopted at the recent annual December meeting of the First District Dental Society of New York City:

WHEREAS, the First District Dental Society recognizes the importance and value of tooth powders, tooth pastes and other dentifrices as an aid to oral health, and

WHEREAS, certain manufacturers of tooth pastes, tooth powders and other dentifrices have recently made extravagant claims for their products, and

WHEREAS, such misleading statements tend to injure the oral health movement as related to public welfare; therefore, be it

Resolved, that the First District Dental Society in regular session assembled condemns the misleading statements of certain manufacturers of tooth pastes, tooth powders and dentifrices; and be it further

Resolved, that each member of the First District Dental Society do all that he can to enlighten his patients regarding the true value of dentifrices.

Lieut.-Col. William C. Speakman Receives Legion of Honor Cross: Lieut.-Col. William C. Speakman, practicing dental surgeon of Wilmington, Del., was recently presented with the cross of the Legion of Honor of France at a dinner given in his honor by members of the Wilmington Club. The presentation was made by the consul of the French Republic at Philadelphia, Rene Weiller. The honor came to Dr. Speakman because of his services to the French Republic during the World War. He has already been the recipient of the Medaille Commemorative la Reconnaissance Francaise, the Victory ribbon with three stars, and the Verdun medal, and he was among a group which as a whole was awarded the Croix de Guerre.

Dr. Aguilar Visits United States: Dr. Florestan Aguilar, of Madrid, Spain, former president of the International Dental Federation, brought two architects from Madrid to this country early in January to discuss designs for the new buildings of the University of Madrid, which will be constructed through the generosity of a resident of Los Angeles. A native of Cuba, Dr. Aguilar was educated at the University of Pennsylvania and went to Spain to begin the practice of his profession. He is now dentist to the royal family of Spain and was recently created a viscount by King Alfonso. He was selected by the World Society of Dentists to head their endeavor to supply clothing and professional materials to the dentists of Russia during the great famine. He is president of the European Dental Federation and was for two years district governor of the Rotary clubs in Spain.

Dentist Having Nurse Give Treatments for Pyorrhea: The District Court of Appeal of California, third district, in reversing a judgment which annulled an order of the state board of dental examiners suspending for a period of five years the petitioner's license to practice dentistry in that state, says that he was charged with unprofessional conduct. The accusation filed with the dental board, on which he was tried and found guilty, alleged that on or about a certain date he did wilfully and unlawfully aid and abet an unlicensed person to practice dentistry in the state of California, in that he did knowingly and unlawfully permit his office nurse to clean teeth and administer treatment for pyorrhea on the gums of a certain named person, at his (the petitioner's) office, and did wilfully, knowingly and unlawfully permit and allow his office nurse, at his office, to clean the teeth of various other persons, at various times, and that during all of these times the office nurse was not licensed to practice dentistry in the state of California. It is a matter of defense in hearings of this kind to show that the person employed in the practice of dentistry has been duly licensed. The burden of proof is on the employer to show that his employee is duly licensed. Where instruments are used in the removal of any accumulations on the teeth, where medicines are employed in treating the gums of a patient, where paste is placed on the teeth as a part of such treatment and thereafter removed by a re-

volving brush, propelled by a power not stated, which is used in removing the paste and as a part of the treatment, this court thinks that a charge of practicing dentistry as defined by the dental act has been made out, and, if one is charged, as in this case, with aiding and abetting an unlicensed person to practice dentistry who in his office performs such acts on his patient, a judgment so finding is supported by the testimony.—Medicolegal Dept., *J. A. M. A.*

DEATHS

Bryant, S. Roy, Rochester, N. Y.; University of Buffalo, School of Dentistry, 1912; died, January 8; aged 42.

Jones, Harry L., Barrington and Chicago, Ill.: University of Illinois College of Dentistry, 1908; died recently; aged 50.

Smith, Owen B., Chicago, Ill.: Chicago College of Dental Surgery, Dental Department of Loyola University, 1902; died, December 12; aged 50.

ANNOUNCEMENTS

CALENDAR OF MEETINGS*

NATIONAL SOCIETIES

American Dental Association, Washington, D. C., Oct. 7-11, 1929.

American Society of Orthodontists, Estes Park, Colo., July 15-19, 1929.

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June inclusive.

March (1929)

Minnesota, at St. Paul (6-8).
Montana, at Butte (28-30).

April (1929)

Alabama, at Birmingham (16-18).
Connecticut, at Waterbury (April 30-May 2).
Kansas, at Wichita (April 29-May 2).
Kentucky, at Louisville (9-11).
Mississippi, at Jackson (22-24).
New Jersey, at Asbury Park (10-13).
Texas, at Beaumont (16-19).
Virginia, at Danville (April 30-May 2).

May (1929)

Arkansas, at Little Rock (20-22).
Illinois, at Springfield (14-16).
Indiana, at Indianapolis (20-22).
Iowa, at Cedar Rapids (7-9).
Maryland, at Baltimore (6-8)
Massachusetts, at Boston (6-10).
Missouri, at St. Joseph (12-14).
Nebraska, at Omaha (20-23).
New York, at Rochester (15-17).
North Dakota, at Grand Forks (14-16).
Pennsylvania, at Scranton (14-16).
Southern California, at Los Angeles (6-7).
Vermont, at Burlington (22-24).
West Virginia, at White Sulphur Springs (27-29).

June (1929)

Colorado, at Colorado Springs (17-19).
Georgia, at Atlanta (12-14).
Maine, at South Poland (20-22).
Michigan, at Detroit (18-20).
Nevada, at Reno (1).

July (1929)

California, at San Francisco (8-12).
Oregon, at San Francisco (8-12).
South Dakota, at Rapid City (1-2).
Utah, at San Francisco (8-12).
Washington, at San Francisco (8-12).
Wisconsin, at Milwaukee (9-11).

*Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

American Dental Society of Europe, London, England, July 29, 1929.

Baltimore City Dental Society, Fourth Annual Midwinter Clinic, Feb. 1-2, 1929.

Dallas Midwinter Clinic, Feb. 11-13, 1929.

Dental Congress of Latin America, Rio de Janeiro, Brazil, July 14-21, 1929.

Southern Society of Orthodontists, Macon, Ga., Jan. 31-Feb. 2, 1929.

KENTUCKY STATE DENTAL ASSOCIATION

The Sixtieth Annual (Homecoming) Meeting of the Kentucky State Dental Association will be held at the Brown Hotel, Louisville, April 9-11.

FRANK B. HOWER, *Secretary,*
Heybrun Bldg.,
Louisville.

REHWINKEL DENTAL SOCIETY

The Rehwinkel Dental Society (Athens, Clinton, Fayette, Gallia, Highland, Jackson, Meigs, Ross and Vinton counties, Ohio) will hold its annual midwinter meeting at Chillicothe, Ohio, Saturday, March 23, 1929, in the Blue and Gold Rooms of the new Highland Community Restaurant, all day and in the evening. The program of essays and clinics will be one of the most extensive ever offered by this society. The latest equipment and apparatus will be exhibited. All ethical dentists are cordially invited.

WILLIAM G. HAMM, *Secretary*
Chillicothe, Ohio

PENNSYLVANIA STATE DENTAL SOCIETY

The Sixty-first Annual Meeting of the Pennsylvania State Dental Society will be held at Scranton, May 14-16, 1929. Leslie Waddill, Jenkins Arcade, Pittsburgh, is manager of exhibits.

C. W. HAGAN, *Secretary,*
1011 Macon Ave., Swissvale P. O.
Pittsburgh

AMERICAN DENTAL SOCIETY OF EUROPE

The next meeting of the American Dental Society of Europe will take place at Grosvenor House, London, England, July 29.

SIDNEY MCCALLIN, *Secretary,*
75 Grosvenor St.
London, England

DENTAL CONGRESS OF LATIN AMERICA

The Third Dental Congress of Latin America will be held in Rio de Janeiro, Brazil, July 14-21, 1929. The International Dental Exhibition will be held at the same time and in the same building.

UNIVERSITY OF IOWA COLLEGE OF DENTISTRY AND ALUMNI CLINIC

The University of Iowa College of Dentistry and Alumni Clinic will present a general clinical program by selected clinicians, and lectures by Ewell Neil, Nashville, Tenn., on "Full Denture Technic," at Iowa City, February 8-9, 1929. Hotel reservations should be made.

L. L. DEYARMAN, *President*
W. R. KINZER, *Secretary*

MICHIGAN STATE DENTAL SOCIETY

The next annual meeting of the Michigan State Dental Society will be held June 18-20, 1929, on board the S. S. Noronic, leaving Detroit on the morning of the 18th.

WILLIAM R. DAVIS, *Secretary,*
Michigan Dept. of Health,
Lansing

ALUMNI OF THE SCHOOL OF DENTAL AND ORAL SURGERY OF COLUMBIA UNIVERSITY

The Alumni of the School of Dental and Oral Surgery of Columbia University will hold the Alumni Day Program, February 12. The annual dinner will be given April 20. The last meeting of the year will be held the last week in May. The Alumni Day Program will consist of table clinics to be held from 9 to 11 a. m., on prosthetics, oral surgery, crowns and bridgework, carving for tooth structure and pathology; and lectures from 11 to 12 a. m. The annual dinner will be a stag affair held in the Hotel Westminster, 420 W. 116 St., opposite Columbia University, at 7:30 p. m., April 20.

JOSEPH SCHROFF, *President*
JAMES HORN, *Secretary*